L P51-P53 USER'S PAGE NO. 1 EQ 84

R0001 PROGRAM NAME- PROG52 DATE- NOV 30, 1966
R0003 MOD NO- 2 LOG SECTION- P51-P53
R0005 MODIFICATION BY- LONSKE ASSEMBLY- SUNDISK REV 30

R0007 FUNCTIONAL DESCRIPTION-

R0008 ALIGNS THE IMU TO ONE OF THREE ORIENTATIONS SELECTED BY THE ASTRONAUT. THE PRESENT IMU ORIENTATION IS KNOWN
R0010 AND IS STORED IN REFSMMAT. THE THREE POSSIBLE ORIENTATIONS MAY BE

R0011 (A) PREFERRED ORIENTATION

R0012 AN OPTIMUM ORIENTATION FOR A PREVIOUSLY CALCULATED MANUEVER. THIS ORIENTATION MUST BE CALCULATED AND
R0014 STORED BY A PREVIOUSLY SELECTED PROGRAM.

R0015 (B) NOMINAL ORIENTATION

R0016 $X_{-SM} = UNIT(Y_{-SM} \times Z_{-SM})$

R0018 $Y_{-SM} = UNIT(V \times R)$
R0019 $-SM \quad - \quad -$

R0020 $Z_{-SM} = UNIT(-R)$
R0021 $-SM \quad -$

R0022 WHERE
R0023 R = THE GEOCENTRIC RADIUS VECTOR AT TIME T(ALIGN) SELECTED BY THE ASTRONAUT
R0025 -

R0026 V = THE INERTIAL VELOCITY VECTOR AT TIME T(ALIGN) SELECTED BY THE ASTRONAUT
R0028 -

R0029 (C) REFSMMAT ORIENTATION

R0030 THIS SELECTION CORRECTS THE PRESENT IMU ORIENTATION. THE PRESENT ORIENTATION DIFFERS FROM THAT TO WHICH IT
R0032 WAS LAST ALIGNED ONLY DUE TO GYRO DRIFT(I.E. NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION HAS OCCURED
R0034 SINCE THE LAST ALIGNMENT).

R0035 AFTER A IMU ORIENTATION HAS BEEN SELECTED ROUTINE S52.2 IS OPERATED TO COMPUTE THE GIMBAL ANGLES USING THE
R0037 NEW ORIENTATION AND THE PRESENT VEHICLE ATTITUDE. CAL52A THEN USES THESE ANGLES, STORED IN THETAD,+1,+2, TO
R0039 COARSE ALIGN THE IMU. THE STAR SELECTION ROUTINE, R56, IS THEN OPERATED. IF 2 STARS ARE NOT AVAILABLE AN ALARM
R0041 IS FLASHED TO NOTIFY THE ASTRONAUT. AT THIS POINT THE ASTRONAUT WILL MANUEVER THE VEHICLE AND SELECT 2 STARS
R0043 EITHER MANUALLY OR AUTOMATICALLY. AFTER 2 STARS HAVE BEEN SELECTED THE IMU IS FINE ALIGNED USING ROUTINE R51. IF
R0045 THE RENDEZVOUS NAVIGATION PROCESS IS OPERATING(INDICATED BY RNDVZFLG) P20 IS DISPLAYED. OTHERWISE P00 IS
R0047 REQUESTED.

R0048 CALLING SEQUENCE-

R0049 THE PROGRAM IS CALLED BY THE ASTRONAUT BY DSKY ENTRY.

```
R0050   SUBROUTINES CALLED-

R0051       1. FLAGDOWN      7. S52.2          13. NEWMODEX
R0052       2. R02BOTH       8. CAL53A         14. PRIOLARM
R0053       3. GOPERF4       9. FLAGUP
R0054       4. MATMOVE      10. R56
R0055       5. GOFLASH      11. R51
R0056       6. S52.3        12. GOPERF3

R0057   NORMAL EXIT MODES-

R0058       EXITS TO ENDOFJOB

R0059   ALARM OR ABORT EXIT MODES-

R0060       NONE

R0061   OUTPUT-

R0062       THE FOLLOWING MAY BE FLASHED ON THE DSKY
R0063          1. IMU ORIENTATION CODE
R0064          2. ALARM CODE 215 -PREFERRED IMU ORIENTATION NOT SPECIFIED
R0065          3. TIME OF NEXT IGNITION
R0066          4. GIMBAL ANGLES
R0067          5. ALARM CODE 405 -TWO STARS NOT AVAILABLE
R0068          6. PLEASE PERFORM P00
R0069       THE MODE DISPLAY MAY BE CHANGED TO 20

R0070   ERASABLE INITIALIZATION REQUIRED-

R0071       PFRATFLG SHOULD BE SET IF A PREFERRED ORIENTATION HAS BEEN COMPUTED. IF IT HAS BEEN COMPUTED IT IS STORED IN
R0073       XSMD,YSMD,ZSMD.
R0074       RNDVZFLG INDICATES WHETHER THE RENDEZVOUS NAVIGATION PROCESS IS OPERATING.

R0076   DEBRIS-

R0077       WORK AREA
 0078   REF   3  LAST  209    15,2000              P54     =        PROG52
 0079                         33,3772                      BANK     33
 0080   REF   1               15,2000                      SETLOC   P50S
 0081                         15,2000                      BANK

 0082   REF   4  LAST  450    30,2000                      SBANK=   LOWSUPER
 0083   REF   7  LAST  446    E5,1773                      EBANK=   SAC
 0084   REF   1                                           COUNT    15/P52

 0085   REF  63  LAST  683    15,2000  0 5301 0  PROG52    TC       PHASCHNG
 0086                         15,2001   00254 1           OCT      00254
 0087   REF  46  LAST  690    15,2002  0 5447 0           TC       DOWNFLAG
 00875  REF  19  LAST  639    15,2003   00027 1           ADRES    UPDATFLG      BIT 7  FLAG 1
```

```
0088  REF  47  LAST  694   15,2004  0 5447 0          TC      DOWNFLAG
00885 REF   7  LAST  639   15,2005   00031 0          ADRES   TRACKFLG     BIT 5  FLAG 1
0089  REF 173  LAST  661   15,2006  0 4555 0          TC      BANKCALL
0090  REF   6  LAST  647   15,2007   17573 0          CADR    R02BOTH      IMU STATUS CHECK
0091  REF  30  LAST  689   15,2010  3 4707 0          CAF     BIT4
0092  REF  37  LAST  629   15,2011  7 0076 1          MASK    STATE +2     IS PFRATFLG SET(PREFERRED ORIENTATION)
0093  REF 164  LAST  690   15,2012  10 000 0          CCS     A
0094  REF   1               15,2013  0 2016 1          TC      P52A         YES
0095  REF  31  LAST  668   15,2014  3 4711 1          CAF     BIT2         NO
0096  REF   2  LAST  695   15,2015  0 2017 0          TC      P52A +1
0097  REF  53  LAST  690   15,2016  3 4712 1  P52A    CAF     BIT1
0098  REF   8  LAST  550   15,2017  55,132 1          TS      OPTION2
0099  REF  54  LAST  695   15,2020  3 4712 1  P52B    CAF     BIT1
0100  REF 174  LAST  695   15,2021  0 4555 0          TC      BANKCALL     FLASH OPTION CODE AND ORIENTATION CODE
0101  REF   1               15,2022   21041 1          CADR    GOPERF4R
0102  REF  42  LAST  648   15,2023  0 4106 1          TC      GOTOPOOH
0103                        15,2024  0 2031 1          TC      +5
0104  REF   1               15,2025  0 2020 1          TC      P52B         NEW CODE - NEW ORIENTATION CODE INPUT
0105  REF  64  LAST  694   15,2026  0 5301 0          TC      PHASCHNG
0106                        15,2027   00014 1          OCT     00014
0107  REF  91  LAST  663   15,2030  0 5112 0          TC      ENDOFJOB
0108  REF   9  LAST  695   15,2031  3 1132 0          CA      OPTION2
0109  REF  24  LAST  690   15,2032  7 6214 1          MASK    THREE
0110  REF 165  LAST  695   15,2033  50 000 1          INDEX   A
0111                        15,2034  0 2035 0          TC      +1
0112  REF   1               15,2035  0 2041 0          TC      P52T         L.S.
0113  REF   1               15,2036  0 2110 0          TC      P52J         PREF
0114  REF   2  LAST  695   15,2037  0 2041 0          TC      P52T         NOM
0115  REF   1               15,2040  1 2120 1          TCF     P52C         REF
0116                        15,2041  0 0006 1  P52T    EXTEND
0117  REF  13  LAST  652   15,2042  3 4714 1          DCA     NEG0
0118  REF  32  LAST  518   15,2043  53,046 0          DXCH    DSPTEM1
0119  REF   1               15,2044  3 2155 1          CAF     V06N34
0120  REF 175  LAST  695   15,2045  0 4555 0          TC      BANKCALL
0121  REF  28  LAST  646   15,2046   20624 0          CADR    GOFLASH
0122  REF  43  LAST  695   15,2047  0 4106 1          TC      GOTOPOOH
0123                        15,2050  0 2052 1          TC      +2
0124                        15,2051  0 2044 0          TC      -5
0125                        15,2052  0 0006 1          EXTEND
0126  REF  33  LAST  695   15,2053  3 1046 1          DCA     DSPTEM1
0127                        15,2054  0 0006 1          EXTEND
0128                        15,2055  1 2057 0          BZF     +2
0129                        15,2056  1 2062 0          TCF     +4

0130                        15,2057  0 0006 1          EXTEND
0131  REF  24  LAST  659   15,2060  3 0025 0          DCA     TIME2
0132  REF  34  LAST  695   15,2061  53,046 0          DXCH    DSPTEM1
0133  REF  10  LAST  695   15,2062  3 1132 0          CA      OPTION2
0134  REF  32  LAST  695   15,2063  7 4711 0          MASK    BIT2
0135  REF 166  LAST  695   15,2064  10 000 0          CCS     A
```

```
0136
0137  REF 157  LAST  663     15,2065  1 2073 0            TCF   +6          NOM
0136                         15,2066  0 6006 1            TC    INTPRET     L8
0139  REF   1                15,2067   77624 1            CALL
0140                         15,2070   34506 0                  P52LS
0141  REF   1                15,2071   77650 1            GOTO
0142  REF 158  LAST  696     15,2072   32100 1                  P52D
0143                         15,2073  0 6006 1            TC    INTPRET
0144  REF  35  LAST  695     15,2074   77745 1            DLOAD
0145                         15,2075   01046 1                  DSPTEM1
0146  REF   1                15,2076   77624 1            CALL
0147                         15,2077   34636 0                  S52.3
0148  REF   1                15,2100   77624 1  P52D      CALL                COMPUTE NOMINAL IMU
0149                         15,2101   22256 0                  S52.2          ORIENTATION
0150  REF   1                15,2102   77776 1            EXIT                READ VEHICLE ATTITUDE AND
0151  REF 176  LAST  695     15,2103   3 2156 1           CAF   V06N22        COMPUTE GIMBAL ANGLES
0152  REF  29  LAST  695     15,2104   0 4555 0           TC    BANKCALL
0153  REF  44  LAST  695     15,2105    20624 0           CADR  GOFLASH       DISPLAY GIMBAL ANGLES
0154                         15,2106   0 4106 1           TC    GOTOPOOH
0155  REF 159  LAST  696     15,2107   0 2113 0           TC    +4            PROCEED
0156                         15,2110   0 6006 1  P52J     TC    INTPRET       RECYCLE- VEHICLE HAS BEEN MENUEVERED
0157  REF   2  LAST  696     15,2111    77650 1           GOTO
0158  REF 160  LAST  696     15,2112    32100 1                 P52D
0159                         15,2113   0 6006 1           TC    INTPRET
0160  REF   1                15,2114    77624 1           CALL
0161                         15,2115    30756 0                 CAL53A        DO COARSE ALIGN
0162  REF   5  LAST  611     15,2116    77414 0           SET   EXIT          ROUTINE
0163  REF   1                15,2117    01462 0                 REFSMFLG
0164  REF 177  LAST  696     15,2120   3 4720 0  P52C     CAF   ALRM15
0165  REF   3  LAST  641     15,2121   0 4555 0           TC    BANKCALL
0166  REF  45  LAST  696     15,2122    20751 0           CADR  GOPERF1
0167                         15,2123   0 4106 1           TC    GOTOPOOH
0168  REF   1                15,2124   0 2126 0           TC    +2            V33
0169  REF 161  LAST  696     15,2125   0 2140 0           TC    P52F          E
0170                         15,2126   0 6006 1           TC    INTPRET
0171  REF  19  LAST  612     15,2127    43234 0           RTB   DAD
0172  REF   1                15,2130    45505 0                 LOADTIME
0173                         15,2131    32176 0                 TSIGHT1
0174  REF   1                15,2132    77624 1           CALL
0175                         15,2133    30216 1                 LOCSAM
0176  REF 176  LAST  696     15,2134    77776 1           EXIT
0177  REF   1                15,2135   0 4555 0  P52E     TC    BANKCALL      DO STAR SELECTION
0178  REF   1                15,2136    30324 1           CADR  PICAPAR
0179  REF 162  LAST  696     15,2137   0 2145 0           TC    P52I          2 STARS NOT AVAILABLE
0180                         15,2140   0 6006 1  P52F     TC    INTPRET       2 STARS AVAILABLE
0181  REF   2  LAST  209     15,2141    77624 1           CALL
0182                         15,2142    30523 0                 R51
0183  REF  46  LAST  696     15,2143    77776 1  ENDP50S  EXIT
0196  REF  27  LAST  676     15,2144   0 4106 1           TC    GOTOPOOH
0197                         15,2145   0 5537 0  P52I     TC    ALARM
                             15,2146    00405 0           OCT   405
```

L P51-P53

```
 0198   REF   3  LAST  551   15,2147  3 4743 0          CAF    V05N09
 0199   REF 179  LAST  696   15,2150  0 4555 0          TC     BANKCALL
 0200   REF  30  LAST  696   15,2151    20624 0         CADR   GOFLASH
 0201   REF  47  LAST  696   15,2152  0 4106 1          TC     GOTOPOOH
 0202   REF   2  LAST  696   15,2153  0 2140 0          TC     P52F        PROCEED - DO FINE ALIGN-R51
 0203   REF   2  LAST  695   15,2154  0 2120 0          TC     P52C        RECYCLE- VEHICLE HAS BEEN MANUEVERED
 0204                        15,2155    01442 1  V06N34  VN     00634
 0205                        15,2156    01426 0  VB06N22 VN     00622
 0206   REF   2  LAST  153      4720               ALRM15  EQUALS CCT15
 0207   REF   1                16,2000            SETLOC P50S2
 0208                          16,2505            BANK
 0209                          16,2505    01531 1  V06N69* VN     0669
R0210   NAME-P52LS
R0211   FUNCTION - TO DISPLAY THE LANDING SITE LATITUDE,
R0212   LONGTITUDE AND ALTITUDE. TO ACCEPT NEW DATA VIA
R0213   THE KEYBOARD. TO COMPUTE THE LANDING SITE
R0214   ORIENTATION FOR P52 OR P54
R0215
R0216   LET'
R0217      RLS = LANDING SITE VECTOR IN REF COORDINATES
R0218      R   = CSM POSITION VECTOR IN REF COORDINATES
R0219      V   = CSM VELOCITY VECTOR IN REF COORDINATES
R0220   THEN THE LANDING SITE ORIENTATION IS'
R0221      XSMD = UNIT(RLS)
R0222      YSMD = UNIT(ZSMD*XSMD)
R0223      ZSMD = UNIT((R*V)*RLS)
R0224   CALL -   CALL
R0225                  P52LS
R0226   INPUTS-  DSPTEM1=TIME OF ALIGNMENT
R0227            RLS=LANDING SITE VECTOR IN MOON FIXED COORINATES
R0228   OUTPUTS- XSMD,YSMD,ZSMD
R0229   SUBROUTINES- RP-TO-R ,LAT-LONG,LLASRD,LLASRDA,CSMPREC
R0230   DEBRIS- VAC, SEE SUBROUTINES
R0231
 0232                          16,2506    43020 1  P52LS   STQ    SET
 0233   REF   2  LAST   70     16,2507    00300 1          QMAJ
 0234   REF  16  LAST  621     16,2510    01463 1          LUNAFLAG
 0235                          16,2511    77745 1  DLOAD
 0236   REF  36  LAST  696     16,2512    01046 1          DSPTEM1
 0237   REF   2  LAST   91     16,2513    02607 1  STORE   TSIGHT
 0238                          16,2514    43175 0  VLOAD   SET
 0239   REF   7  LAST  599     16,2515    02026 1          RLS
 0240   REF   7  LAST  635     16,2516    00462 1          BRADFLAG
 0241                          16,2517    14001 0  STODL   0D
 0242   REF   3  LAST  697     16,2520    02607 1          TSIGHT
 0243                          16,2521    34007 1  STCALL  6D
 0244   REF   3  LAST  596     16,2522    55341 1          RP-TO-R
 0245                          16,2523    77742 0  VSR2
 0246   REF   6  LAST  616     16,2524    16152 0  STODL   ALPHAV
 0247   REF   4  LAST  697     16,2525    02607 1          TSIGHT
```

```
0248
0249  REP   4  LAST  599      16,2526   77624 1          CALL
0252                          16,2527   26322 0                LAT-LONG
0253  REP   2  LAST  599      16,2530   77624 1          CALL
0254                          16,2531   61336 0                LLASRD
0255  REP   1                 16,2532   77776 1          EXIT
0256  REP 180  LAST  697      16,2533   3 2505 0 LSDISP  CAP    V06N69*
0257  REP  31  LAST  697      16,2534   0 4555 0         TC     BANKCALL
0258  REP  48  LAST  697      16,2535    20624 0         CADR   GOPLASH
0259                          16,2536   0 4106 1         TC     GOTOPOOH
0260  REP   1                 16,2537   0 2541 0         TC     +2
0261  REP 163  LAST  696      16,2540   0 2533 0         TC     LSDISP
0262                          16,2541   0 6006 1         TC     INTPRET
0263  REP   3  LAST  614      16,2542    77624 1         CALL
0264                          16,2543    61345 1               LLASRDA
0265  REP   5  LAST  697      16,2544    45145 0         DLOAD  CALL
0266  REP   5  LAST  635      16,2545    02607 1                TSIGHT
0267                          16,2546    26373 1                LALOTORV
0268  REP   9  LAST  697      16,2547    53575 0         VLOAD  UNIT
0269  REP   3  LAST   71      16,2550    02152 0                ALPHAV
0270  REP   6  LAST  698      16,2551    14307 0         STODL  XSMD
0271  REP  38  LAST  666      16,2552    02607 1                TSIGHT
0272  REP   5  LAST  596      16,2553    34041 0         STCALL TDEC1
0273                          16,2554    27022 1                CSMPREC
0274  REP  22  LAST  666      16,2555    47375 0         VLOAD  VXV
0275  REP  16  LAST  668      16,2556    00001 0                RATT
0276                          16,2557    00007 0                VATT
0277  REP   4  LAST  696      16,2560    53435 0         VXV    UNIT
0278  REP   2  LAST   71      16,2561    00307 0                XSMD
0279                          16,2562    00323 0         STORE  ZSMD
0280  REP   5  LAST  696      16,2563    53435 0         VXV    UNIT
0281  REP   3  LAST   71      16,2564    00307 0                XSMD
0282  REP   3  LAST  697      16,2565    34315 1         STCALL YSMD
0283  REP   1                 16,2566    00300 1                QMAJ
0284                          14,2000         1         SETLOC P50S1
R0285 NAME- AUTOMATIC OPTICS POSITIONING ROUTINE                 BANK
                              14,2002

R0286 FUNCTION- (1) TO POINT THE STAR LOS OF THE OPTICS AT A STAR OR LANDMARK DEFINED BY THE PROGRAM OR BY DSKY INPUT.
R0288           (2) TO POINT THE STAR LOS OF THE OPTICS AT THE LEM DURING RENDEZVOUS TRACKING OPERATIONS.

R0290 CALLING SEQUENCE- CALL R52

R0291 INPUT- 1. TARG1FLG AND TARG2FLG- PRESET BY CALLER
R0292        2. RNDVZFLG AND TRACKFLG- PRESET BY CALLER
R0293        3. STAR CODE- PRESET BY CALLER. ALSO INPUT THROUGH DSKY
R0294        4. LAT, LONG AND ALT OF LANDMARK- INPUT THROUGH DSKY
R0295        5. NO. OF MARKS(MARKINDX)- PRESET BY CALLER

R0296 OUTPUT- DRIVE SHAFT AND TRUNNION CDUS
```

R0297 SUBROUTINES- 1. PIXDELAY 7. CLEANDSP
R0298 2. GOPERF1 8. GODSPR
R0299 3. GOFLASH 9. REFLASHR
R0300 4. R53 10. R52.2
R0301 5. ALARM 11. R52.3
R0302 6. SR52.1

```
0303   REP   1                                                    COUNT   15/R52

0304                          14,2002   43020 1   R52    STQ     CLEAR
0305   REP   2  LAST   91     14,2003   02576 1          STQ     SAVOR52
0306   REP   1                14,2004   04265 1          ADVTRK
0307                          14,2005   77776 1   R52VRB EXIT
0308                          14,2006   0 0006 1         EXTEND
0309   REP   6  LAST  500     14,2007   3 0036 1         DCA     CDUT
0310   REP   6  LAST  446     14,2010   53#161 1         DXCH    DESOPTT
0311   REP 164  LAST  696     14,2011   0 6006 1         TC      INTPRET
0312                          14,2012   43131 0          SSP     CLEAR
0313   REP  25  LAST  666     14,2013   01304 1                  OPTIND
0314                          14,2014   00000 1                  0
0315   REP   1                14,2015   00271 0                  R53FLAG
0316                          14,2016   77776 1          EXIT
0317   REP 165  LAST  699     14,2017   0 6006 1   R52A  TC      INTPRET
0318                          14,2020   43014 0          SET     BON
0319   REP   1                14,2021   00073 0                  TRUNFLAG
0320   REP   4  LAST  610     14,2022   00705 0                  TARG1FLG
0321   REP   1                14,2023   30103 0                  R52H
0322                          14,2024   77414 0          CLEAR   EXIT
0323   REP   1                14,2025   03660 1                  TERMIFLG
0324   REP   6  LAST  236     14,2026   3 1314 0   R52C  CA      SWSAMPLE        IS OPTICS MODE IN AGC
0325                          14,2027   0 0006 1         EXTEND
0326   REP   1                14,2030   6 2131 0         BZMF    R52M            MANUAL
0327   REP 161  LAST  696     14,2031   0 4555 0   R52D  TC      BANKCALL        AGC
0328   REP   1                14,2032   26176 0          CADR    SR52.1
0329   REP   1                14,2033   1 2161 1         TCF     R52L            GR 90 DEGREES
0330   REP   1                14,2034   1 2124 0         TCF     R52J            GR 50 DEGREES
0331   REP  43  LAST  663     14,2035   0 5435 0         TC      UPFLAG          LS 50 DEGREES
0332   REP   2  LAST  699     14,2036   00013 0          ADRES   TRUNFLAG        SET TRUNFLAG  BIT 4  FLAG 0
0333   REP  29  LAST  669     14,2037   3 4701 0   R52JA CAF     BIT10           IS THIS A LEM
0334   REP  36  LAST  695     14,2040   7 0075 1         MASK    STATE +1
0335   REP 167  LAST  695     14,2041   10 000 0         CCS     A
0336   REP   1                14,2042   0 2052 1         TC      R52E            YES
0337   REP  33  LAST  550     14,2043   3 4705 1         CAF     BIT6            NO, IS R53FLAG SET
0338   REP  39  LAST  699     14,2044   7 0074 0         MASK    STATE
0339   REP 168  LAST  699     14,2045   10 000 0         CCS     A
0340   REP   2  LAST  699     14,2046   1 2052 0         TCF     R52E            YES
0341   REP   1                14,2047   3 2151 0         CAF     V06N92          NO
0342   REP 182  LAST  699     14,2050   0 4555 0         TC      BANKCALL
0343   REP   2  LAST  384     14,2051   20602 1          CADR    GODSPR
0344   REP   9  LAST  699     14,2052   3 1314 0   R52E  CA      SWSAMPLE        IS OSS IN CMC MODE
```

```
0345
0346  REF   1
0347  REF  40  LAST  699      14,2053  0 0006 1            EXTEND
0348  REF  31  LAST  695      14,2054  6 2065 0            BZMF   R52F          NO
0349  REF 169  LAST  699      14,2055  4 0074 0            CS     STATE         YES- IS TRUNFLAG SET
0350                          14,2056  7 4707 1            MASK   BIT4
0351  REF   7  LAST  446      14,2057  10 000 0            CCS    A
0352  REF   7  LAST  699      14,2060  0 2063 0            TC     +3            NO
0353  REF   6  LAST  694      14,2061  3 1775 0            CA     PAC           YES
0354  REF   5  LAST  446      14,2062  55=160 0            TS     DESOPTT
0355  REF   5  LAST  527      14,2063  3 1773 0            CA     SAC
0356  REF 163  LAST  699      14,2064  55=161 1            TS     DESOPTS
0357  REF  10  LAST  643      14,2065  3 4731 0  R52F      CAF    .5SEC         WAIT 1/2 SEC
0358  REF  30  LAST  699      14,2066  0 4555 0            TC     BANKCALL
0359  REF  41  LAST  700      14,2067   01732 0            CADR   DELAYJOB
0360  REF 170  LAST  700      14,2070  3 4701 0            CAF    BIT10
0361  REF   1                 14,2071  7 0075 1            MASK   STATE +1
0362  REF  35  LAST  669      14,2072  10 000 0            CCS    A
0363  REF  42  LAST  700      14,2073  1 2104 1            TCF    R52HA         YES, LEM
0364                          14,2074  3 4674 0            CAF    BIT15         NO
0365  REF   1                 14,2075  7 0103 1            MASK   STATE +7      IS TERM1FLG SET
0366  REF 166  LAST  699      14,2076  0 0006 1            EXTEND
0367                          14,2077  1 2026 0            BZF    R52C          NO
0368  REF   3  LAST  699      14,2100  0 6006 1  R52Q      TC     INTPRET       YES
0369                          14,2101   77650 1            GOTO
0370  REF 164  LAST  700      14,2102   02576 1                   SAVOR52
0371  REF   2  LAST  554      14,2103   77776 1  R52H      EXIT                 LEM
0372  REF  43  LAST  700      14,2104  0 4555 0  R52HA     TC     BANKCALL
0373  REF  31  LAST  611      14,2105   76536 0            CADR   R61CSM
0374                          14,2106  3 0075 0            CA     STATE +1
0375  REF   1                 14,2107  7 4706 0            MASK   BIT5
                              14,2110  0 0006 1            EXTEND                TRACKFLG
03751 REF  44  LAST  700      14,2111  1 2100 0            BZF    R52Q

03752 REF  41  LAST  669      14,2112  4 0075 1            CS     STATE +1
03753 REF 171  LAST  700      14,2113  7 4704 1            MASK   BIT7          UPDATFLG
03754 REF   1                 14,2114  10 000 0            CCS    A
                              14,2115  1 2122 0            TCF    R52SYNC

0376  REF  45  LAST  700      14,2116  3 0101 1  R52I      CA     STATE +5
0377  REF  31  LAST  700      14,2117  7 4701 1            MASK   BIT10
0376  REF 172  LAST  700      14,2120  10 000 0            CCS    A
0379  REF   1                 14,2121  0 2031 1            TC     R52D          PRFTRKAT = 1
0360  REF   1                 14,2122  3 2175 0  R52SYNC   CAF    1.6SEC        MAKE UP FOR LOST TIME
03801 REF   2  LAST  700      14,2123  1 2066 1            TCF    R52F +1

0381  REF  46  LAST  695      14,2124  0 5447 0  R52J      TC     DOWNFLAG      CLEAR TRUNFLAG
0382  REF   3  LAST  699      14,2125   00013 0            ADRES  TRUNFLAG      BIT 4  FLAG 0
0383  REF  28  LAST  696      14,2126  0 5537 0            TC     ALARM         SET 407 ALARM
0384                          14,2127   00407 1            OCT    407
0385  REF   1                 14,2130  0 2037 1            TC     R52JA
0386  REF  34  LAST  699      14,2131  3 4705 1  R52M      CAF    BIT8          IS R53FLAG SET
```

```
0367  REF  46  LAST  700   14,2132  7 0074 0          MASK   STATE
0386  REF 173  LAST  700   14,2133  10 000 0          CCS    A
0389  REF   3  LAST  700   14,2134  0 2065 0          TC     R52P          YES
0390                       14,2135  0 0004 0          INHINT               NO
0391  REF   1              14,2136  3 7661 1          CAF    PRIO24
0392  REF  26  LAST  665   14,2137  0 5042 1          TC     FINDVAC
0393  REF   9  LAST  700   E5,1773                     EBANK= SAC
0394  REF   1              14,2140   02144 1          2CADR  R53JOB
0394  REF   1              14,2141   30085 1
0395                       14,2142  0 0003 1          RELINT
0396  REF   4  LAST  701   14,2143  1 2085 1          TCF    R52P
0397  REF 167  LAST  700   14,2144  0 6008 1 R53JOB   TC     INTPRET
0398                       14,2145   77624 1          CALL
0399  REF   2  LAST  611   14,2146   31322 0                 R53
0400                       14,2147   77776 1 ENDPLAC  EXIT                 INTERPRETER RETURN TO ENDOFJOB(R22 USES)
0401  REF  92  LAST  695   14,2150  0 5112 0          TC     ENDOFJOB
0402                       14,2151   01534 1 V08N92   VN     00892
0403                       14,2152   01531 1 V08N89A  VN     0689
0404                       14,2153   10464 0 SHAXIS   2DEC   .5376381241 B-1
0404                       14,2154   12470 1

0405                       14,2155   00000 1          2DEC   0
0405                       14,2156   00000 1
0406                       14,2157   15373 1          2DEC   .6431766920 B-1
0408                       14,2160   11554 0
0407  REF  32  LAST  700   14,2161  3 4701 0 R52L     CAF    BIT10          IS THIS A LEM
0408  REF  47  LAST  701   14,2162  7 0075 1          MASK   STATE +1
0409  REF 174  LAST  701   14,2163  10 000 0          CCS    A
0410  REF   2  LAST  699   14,2164  0 2124 1          TC     R52J           YES
0411  REF   1              14,2165  3 2174 1          CAF    OCT404
0412  REF 185  LAST  700   14,2166  0 4555 0          TC     BANKCALL
0413  REF   1              14,2167   21671 1          CADR   PRIOLARM
0414  REF   2  LAST  226   14,2170  1 2176 1          TCF    TERM52         TERMINATE
0415  REF   5  LAST  701   14,2171  1 2085 1          TCF    R52P           PROCEED
0418  REF   6  LAST  701   14,2172  1 2085 1          TCF    R52P           NO PROVISION FOR NEW DATA
0417  REF  93  LAST  701   14,2173  1 5112 1          TCF    ENDOFJOB

0418                       14,2174   00404 1 OCT404   OCT    404

04185                      14,2175   00284 1 1.8SEC   DEC    180

0419  REF   3  LAST  226   14,2176  0 5425 1 TERM52   TC     CLEARMRK

0421  REF 186  LAST  701   14,2177  0 4555 0          TC     BANKCALL       KILL MARK SYSTEM
0422  REF   6  LAST  590   14,2200   16083 0          CADR   MKRELEAS

0423  REF 143  LAST  889   14,2201  3 4714 1          CAF    ZERO
0424  REF   3  LAST  236   14,2202  55=323 0          TS     OPTCADR

0425  REF 187  LAST  701   14,2203  0 4555 0          TC     BANKCALL       CLEAR OUT EXTENDED VERBS
```

L P51-P53

USER'S PAGE NO. 10 E5 S3

```
0426  REF   3  LAST  563   14,2204   20464 0          CADR   KLEENEX
0427  REF  49  LAST  698   14,2205   0 4106 1         TC     GOTOPOOH     NOW GO TO POO
0428
                           14,2206   43020 1  ADVORB  STQ    SET          SETS UP ADVANCED ORBIT TRACKING
0429  REF   4  LAST  700   14,2207   02576 1                 SAVORS2
0430  REF   2  LAST  699   14,2210   04065 0                 ADVTRK
0431
                           14,2211   43014 0          SET    SET
0432  REF  17  LAST  697   14,2212   01463 1                 LUNAFLAG
0433  REF   6  LAST  697   14,2213   00462 1                 ERADFLAG
0434
                           14,2214   77650 1          GOTO
0435  REF   1              14,2215   30005 1                 R52VRB
```

```
R0436   NAME -S50 ALIAS  LOCSAM
R0437   NAME- LOCSAM
R0438   FUNCTION -TO COMPUTE QUATITIES LISTED BELOW ,USED IN THE
R0439            IMU ALIGNMENT PROGRAMS
R0440   DEFINE'
R0441        RATT=POSITION VECTOR OF CM  WRT PRIMARY BODY
R0442        VATT=VELOCITY VECTOR OF CM  WRT PRIMARY BODY
R0443        RE  =RADIUS OF EARTH
R0444        RM  =RADIUS OF MOON
R0445        ECLIPOL= POLE OF ECLIPTIC SCALED BY TANGENTIAL VELOCITY OF EARTH
R0446                 WRT TO SUN  OVER  THE VELOCITY OF LIGHT
R0447        REM =POSITION OF MOON  WRT  EARTH
R0448        RES =POSITION OF SUN  WRT EARTH
R0449        C = VELOCITY OF LIGHT
R0450
R0451
R0452            EARTH IS PRIMARY                MOON IS PRIMARY
R0453                    -                               -
R0454            VEARTH=-1(RATT)                 VEARTH=-1(REM+RATT)
R0455
R0456                    -                               -
R0457            VMOON= 1(REM-RATT)              VMOON =-1(RATT)
R0458
R0459                    -                               -
R0460            VSUN = 1(RES)                   VSUN  =1(RES-REM)
R0461
R0462                           -1
R0463            CEARTH=COS( SIN (RE/RATT)+5)    CEARTH=COS 5
R0464
R0465                                                   -1
R0466            CMOON= COS 5                    CMOON=COS( SIN (REM/RATT)+5)
R0467
R0468
R0469            CSUN = COS 15                   CSUN = COS 15
R0470
R0471                        VEL/C = VSUN X ECLIPOL + VATT/C
R0472
R0473
R0474
R0475
R0476   CALL -   DLOAD  CALL
R0477                   DESIRED TIME
R0478                   LOCSAM
R0479   INPUTS - MPAC = TIME
R0480
R0481   OUTPUTS- VEARTH,VMOON,VSUN,CEARTH,CMOON,CSUN,VEL/C
R0482
R0483   SUBROUTINES- LSPOS,CSMCONIC
R0484
R0485   DEBRIS - VAC AREA,SEE SUBROUTINES
```

```
R0486
 0487   REF   2  LAST  698   14,2000                        SETLOC  P50S1
 0488                        14,2216                        BANK

 0489   REF   1                                            COUNT*  $$/S50

 0490   REF   1              14,2216                LOCSAM  =       S50
 0491                        14,2216   77620 0      S50     STQ
 0492   REF   4  LAST  698   14,2217   00300 1              CMAJ
 0493   REF   7  LAST  698   14,2220   36607 0              STCALL  TSIGHT
 0494   REF   1              14,2221   54110 0              LSPOS
 0495   REF   2  LAST   93   14,2222   26752 0              STOVL   VMOON
 0496                        14,2223   00003 1              2D
 0497   REF   2  LAST   93   14,2224   16744 1              STODL   VSUN
 0498   REF   8  LAST  704   14,2225   02607 1              TSIGHT
 0499   REF  39  LAST  698   14,2226   34041 0              STCALL  TDEC1
 0500   REF   5  LAST  586   14,2227   27045 0              CSMCONIC
 0501                        14,2230   61131 0              SSP     TIX,2
 0502   REF  10  LAST  624   14,2231   00052 0              S2
 0503                        14,2232   00000 1              0
 0504   REF   1              14,2233   30256 0              MOONCNTR
 0505                        14,2234   52375 1  EARTCNTR    VLOAD   VSU
 0506   REF   3  LAST  704   14,2235   02752 0              VMOON
 0507   REF  23  LAST  698   14,2236   00001 0              RATT
 0508                        14,2237   77656 1              UNIT
 0509   REF   4  LAST  704   14,2240   26752 0              STOVL   VMOON
 0510   REF  24  LAST  704   14,2241   00001 0              RATT
 0511                        14,2242   57456 1              UNIT    VCOMP
 0512   REF   3  LAST   93   14,2243   16736 1              STODL   VEARTH
 0513   REF   1              14,2244   32162 0              RSUBE
 0514                        14,2245   77624 1              CALL
 0515   REF   1              14,2246   30316 0                      OCCOS
 0516   REF   1              14,2247   14017 1              STODL   CEARTH
 0517   REF   1              14,2250   32200 1                      CSS5
 0518   REF   1              14,2251   24023 0              STOVL   CMOON
 0519   REF   3  LAST  704   14,2252   02744 1                      VSUN
 0520                        14,2253   77656 1              UNIT
 0521   REF   4  LAST  704   14,2254   36744 0              STCALL  VSUN
 0522   REF   1              14,2255   30303 1                      ENDSAM
 0523                        14,2256   40575 1  MOONCNTR    VLOAD   VSR8
 0524   REF   5  LAST  704   14,2257   02752 0                      VMOON
 0525                        14,2260   51362 1              VSR1    BVSU
 0526   REF   5  LAST  704   14,2261   02744 1                      VSUN
 0527                        14,2262   77656 1              UNIT
 0528   REF   6  LAST  704   14,2263   26744 1              STOVL   VSUN
 0529   REF   6  LAST  704   14,2264   02752 0                      VMOON
 0530                        14,2265   53455 0              VAD     UNIT
 0531   REF  25  LAST  704   14,2266   00001 0                      RATT
 0532                        14,2267   77676 0              VCOMP
 0533   REF   4  LAST  704   14,2270   26736 1              STOVL   VEARTH
```

```
0534  REP  26  LAST  704   14,2271  00001 0            RATT
0535                       14,2272  57456 1      UNIT  VCOMP
0536  REP   7  LAST  704   14,2273  16752 0      STODL VMOON
0537  REP   1              14,2274  32160 1            RSUBM
0538                       14,2275  77624 1      CALL
0539  REP   2  LAST  704   14,2276  30316 0            CCCOS
0540  REP   2  LAST  704   14,2277  14023 0      STODL CMOON
0541  REP   2  LAST  704   14,2300  32200 1            CSS5
0542  REP   2  LAST  704   14,2301  24017 1      STOVL CEARTH
0543  REP   7  LAST  704   14,2302  02744 1            VSUN
0544                       14,2303  77635 1  ENDSAM  VXV
0545  REP   1              14,2304  32170 0            ECLIPOL
0546  REP   2  LAST  115   14,2305  27474 0      STOVL VEL/C
0547  REP  19  LAST  698   14,2306  00007 0            VATT
0548                       14,2307  53361 0      VXSC  VAD
0549  REP   1              14,2310  32166 1            1/C
0550  REP   3  LAST  705   14,2311  03474 0            VEL/C
0551  REP   4  LAST  705   14,2312  17474 0      STODL VEL/C
0552  REP   1              14,2313  32202 0            CSSUN
0553  REP   1              14,2314  34021 0      STCALL CSUN
0554  REP   5  LAST  704   14,2315  00300 1            CMAJ
0555                       14,2316  70471 1  CCCOS   DDV   SR1
0556                       14,2317  00045 0            36D
0557                       14,2320  43336 0      ASIN  DAD
0558  REP   1              14,2321  32164 0            5DEGREES
0559                       14,2322  70546 1      COS   SR1
0560                       14,2323  77616 0      RVQ
0561  REP   2  LAST  694   15,2000                     SETLOC P50S
0562                       15,2157                     BANK
0563                       15,2157  00065 1  RSUBM   2DEC  1738090 B-29     MOON RADIUS IN METERS
0563                       15,2160  01265 1
0564                       15,2161  00302 0  RSUBE   2DEC  6378166 B-29
0564                       15,2162  24533 1
0565                       15,2163  00343 0  5DEGREES 2DEC  .013888889       SCALED IN REVS
0565                       15,2164  21616 0
0566                       15,2165  00000 1  1/C     2DEC  .000042699 B-1   *
0566                       15,2166  13143 0
0567                       15,2167  00000 1  ECLIPOL  2DEC  0               *
0567                       15,2170  00000 1
0568                       15,2171  77777 0            2DEC  -.00007896 B-1  *
0568                       15,2172  53231 1
0569                       15,2173  00001 0            2DEC  .00018209 B-1   *          * FOR USE BY CSM ONLY
0569                       15,2174  17570 0
0570                       15,2175  00001 0  TSIGHT1  2DEC  24000
0570                       15,2176  16700 1
0571                          0016          CEARTH  =     14D
0572                          0020          CSUN    =     16D
0573                          0022          CMOON   =     18D
0574                       15,2177  07760 1  CSS5    2DEC  .2490475         (COS 5)/4
0574                       15,2200  14473 1
```

L P51-P53

USER=S PAGE NO. 14 E5 S3

```
0575                    15,2201   07564 1  CSSUN    2DEC    .24148        COS 15  /4
0575                    15,2202   15042 0
```

```
P0576   PROGRAM NAME - PICAPAR          DATE DEC 20 66
R0577   MOD 1                           LOG SECTION P51-P53
R0576                                   ASSEMBLY  SUNDISK  REV40
R0579   BY KEN VINCENT
R0560
R0581   FUNCTION
R0582     THIS PROGRAM READ THE IMU-CDUS AND COMPUTES THE VEHICLE ORIENTATION
R0563   WITH RESPECT TO INERTIAL SPACE. IT THEN COMPUTES THE SHAFT AXIS (SAX)
R0584   WITH RESPECT TO REFERENCE INERTIAL. EACH STAR IN THE CATALOG IS TESTED
R0585   TO DETERMINE IF IT IS OCCULTED BY EITHER THE EARTH,SUN OR MOON. IF A
R0586   STAR IS NOT OCCULTED  THEN IT IS PAIRED WITH ALL STAR OF LOWER INDEX.
R0587   THE PAIRED STAR  IS TESTED FOR OCCULTATION. PAIRS OF STARS THAT PASS
R0588   THE OCCULTATION TESTS ARE TESTED FOR GOOD SEPARATION.A PAIR OF STARS
R0589   HAVE GOOD SEPARATION IF THE ANGLE BETWEEN THEM IS LESS THAN 66DEGREES
R0590   AND MORE THAN 40DEGREES. THOSE PAIRS OF STARS WITH GOOD SEPARATION
R0591   ARE THEN TESTED TO SEE IF THEY LIE IN CURRENT FIELD OF VIEW.(WITHIN
R0592   33DEGREES OF SAX). THE PAIR WITH MAXIMUM SEPARATION IS CHOSEN FROM
R0593   THOSE WITH GOOD SEPARATION,AND      IN FIELD OF VIEW.
R0594
R0595   CALLING SEQUENCE
R0596   L       TC      BANKCALL
R0597   L+1     CADR    PICAPAR
R0598   L+2     ERROR RETURN - NO STARS IN FIELD OF VIEW
R0599   L+3     NORMAL RETURN
R0600
R0601   OUTPUT
R0602   BESTI,BESTJ -SINGLE PREC,INTEGERS,STAR NUMBERS TIMES 6
R0603   VFLAG - FLAG BIT  SET IMPLIES NO STARS IN FIELD OF VIEW
R0604
R0605   INITIALIZATION
R0606   1)A CALL TO LOCSAM MUST BE MADE
R0607   2)VEARTH = -UNIT(R)  WHERE R HAS BEEN UPDATED TOO APPROXIMATE TIME OF
R0608         SIGHTINGS.
R0609
R0610   DEBRIS
R0611   WORK AREA
R0612   X,Y,ZNB
R0613   SINCDU,COSCDU
R0614   STARAD - STAR +5
 0615   REF   1                                          COUNT  14/PICAP

 0616   REF   3  LAST  704   14,2000                    SETLOC P50S1
 0617                        14,2324                    BANK
 0618   REF   3  LAST  564   14,2324  0 4604 1  PICAPAR TC     MAKECADR
 0619   REF   3  LAST  554   14,2325  55"777 0          TS     OMIN
 0620   REF 166  LAST  701   14,2326  0 6006 1          TC     INTPRET
 0621                        14,2327   77624 1          CALL
 0622   REF   6  LAST  673   14,2330   47432 1                 CDUTRIG
 0623                        14,2331   77624 1          CALL
 0624   REF   1              14,2332   34567 1                 CALCSMSC
```

```
0625
0626
0627
0628  REF   1
0629  REF   1
0630  REF   8  LAST  611
0631  REF   4  LAST  424
0632
0633  REF   1
0634  REF   4  LAST  417
0635
0636
0637  REF   1
0638
0639
0640  REF  21  LAST  677
0641  REF   1
0642
0643  REF  25  LAST  636
0644
0645  REF  11  LAST  704
0646
0647
0648  REF   1
0649  REF   1
0650
0651  REF   2  LAST  622
0652  REF   1
0653
0654  REF   4  LAST  283
0655  REF   1
0656  REF  31  LAST  676
0657
0658  REF   1
0659  REF   2  LAST  706
0660
0661  REF   3  LAST  708
0662  REF   2  LAST  708
0663
0664  REF   5  LAST  708
0665  REF   1
0666  REF   4  LAST  708
0667
0668  REF   5  LAST  708
0669  REF   1
0670
0671  REF   2  LAST  706
0672  REF   1
0673
0674  REF   3  LAST  706

14,2333  77601 0          SETPD
14,2334  00001 0                0
14,2335  71214 0          SET   DLOAD      VFLAG = 1
14,2336  01465 1                VFLAG
14,2337  11456 0                DPZERO
14,2340  24303 1          STOVL BESTI
14,2341  02714 1                XNB
14,2342  63361 0          VXSC  PDVL
14,2343  30502 0                SIN33
14,2344  02730 1                ZNB
14,2345  74370 0          AXT,1 VXSC
14,2346  00344 1                228D             X1 = 37 X 6 +6
14,2347  30504 0                COS33
14,2350  77655 1          VAD
14,2351  53505 1          VXM   UNIT
14,2352  01736 1                REFSMMAT
14,2353  02760 1          STORE SAX              SAX = SHAFT AXIS
14,2354  66331 0          SSP   SSP              S1=S2=6
14,2355  00051 0                S1
14,2356  00006 1                6
14,2357  00052 0                S2
14,2360  00006 1                6
14,2361  52100 1  PIC1    TIX,1 GOTO       MAJOR STAR
14,2362  30364 0                PIC2
14,2363  30513 0                PICEND
14,2364  45173 0  PIC2    VLOAD* CALL
14,2365  31744 1                CATLOG,1
14,2366  30457 1                OCCULT
14,2367  73014 0          BON   LXA,2
14,2370  01710 0                CULTFLAG
14,2371  30361 0                PIC1
14,2372  00046 0                X1
14,2373  52104 0  PIC3    TIX,2 GOTO
14,2374  30376 0                PIC4
14,2375  30361 0                PIC1
14,2376  45173 0  PIC4    VLOAD* CALL
14,2377  46033 0                CATLOG,2
14,2400  30457 1                OCCULT
14,2401  76614 0          BON   VLOAD*
14,2402  01710 0                CULTFLAG
14,2403  30373 0                PIC3
14,2404  31744 1                CATLOG,1
14,2405  45237 0          DOT*  DSU
14,2406  46033 0                CATLOG,2
14,2407  30506 1                CSS66            SEPERATION LESS THAN 66 DEG.
14,2410  43240 0          BMN   DAD
14,2411  30373 0                PIC3
14,2412  30510 0                CSS6640          SEPERATION MORE THAN 40 DEG.
14,2413  77644 1          BPL
14,2414  30373 0                PIC3
```

```
0675                                14,2415  50373 0          VLOAD*  DOT
0676  REF    6  LAST  708           14,2416  31744 1                  CATLOG,1
0677  REF    2  LAST  706           14,2417  02760 1                  SAX
0678                                14,2420  50025 0          DSU     BMN        MAJOR STAR IN CONE
0679  REF    1                      14,2421  30512 1                  CSS33
0680  REF    3  LAST  708           14,2422  30361 0                  PIC1
0681                                14,2423  50373 0          VLOAD*  DOT
0682  REF    7  LAST  709           14,2424  46033 0                  CATLOG,2
0683  REF    3  LAST  709           14,2425  02760 1                  SAX
0684                                14,2426  51025 1          DSU     BPL
0685  REF    2  LAST  709           14,2427  30512 1                  CSS33
0686  REF    1                      14,2430  30433 0                  STRATGY
0687                                14,2431  77650 1          GOTO
0688  REF    4  LAST  706           14,2432  30373 0                  PIC3
0689                                14,2433  77614 1  STRATGY BONCLR
0690  REF    2  LAST  706           14,2434  01605 0                  VFLAG
0691  REF    1                      14,2435  30452 1                  NEWPAR
0692                                14,2436  65120 1          XCHX,1  XCHX,2
0693  REF    9  LAST  706           14,2437  00302 0                  BESTI
0694  REF    2  LAST   70           14,2440  00303 1                  BESTJ
0695                                14,2441  47773 1  STRAT   VLOAD*  DOT*
0696  REF    8  LAST  709           14,2442  31744 1                  CATLOG,1
0697  REF    9  LAST  709           14,2443  46033 0                  CATLOG,2
0698                                14,2444  43006 0          PUSH    BOFINV
0699  REF    3  LAST  709           14,2445  01545 1                  VFLAG
0700  REF    1                      14,2446  30436 0                  STRAT -3
0701                                14,2447  45345 1          DLOAD   DSU
0702                                14,2450  77644 1                  BPL
0703  REF    5  LAST  709           14,2451  30373 0                  PIC3
0704                                14,2452  67130 1  NEWPAR  SXA,1   SXA,2
0705  REF   10  LAST  709           14,2453  00302 0                  BESTI
0706  REF    3  LAST  709           14,2454  00303 1                  BESTJ
0707                                14,2455  77650 1          GOTO
0708  REF    6  LAST  709           14,2456  30373 0                  PIC3
0709                                14,2457  51321 0  CCCULT  MXV     BVSU
0710  REF    1                      14,2460  02736 1                  CULTRIX
0711  REF    1                      14,2461  00017 1                  CSS
0712                                14,2462  77654 0          BZE
0713  REF    1                      14,2463  30476 1                  CULTED
0714                                14,2464  75240 0          BMN     SIGN
0715  REF    2  LAST  709           14,2465  30476 1                  CULTED
0716  REF  272  LAST  663           14,2466  00160 0                  MPAC +3
0717                                14,2467  75240 0          BMN     SIGN
0718  REF    3  LAST  709           14,2470  30476 1                  CULTED
0719  REF  273  LAST  709           14,2471  00162 1                  MPAC +5
0720                                14,2472  43040 1          BMN     CLRGO
0721  REF    4  LAST  709           14,2473  30476 1                  CULTED
0722  REF    6  LAST  708           14,2474  01630 0                  CULTFLAG
0723  REF   13  LAST  624           14,2475  00052 0                  OPRET
0724                                14,2476  77614 1  CULTED  SETGO
```

```
0725  REP  7  LAST  709   14,2477   01430 1                    CULTFLAG
0726  REP 14  LAST  709   14,2500   00052 0                    QPRET
0727  REP  3  LAST  705      0016             CSS      =      CEARTH
0728                      14,2501   21150 0  SIN33    2DEC   .5378381241
0728                      14,2502   25157 0
0729                      14,2503   32766 1  COS33    2DEC   .8431758920
0729                      14,2504   22713 1
0730                      14,2505   01736 1  CSS66    2DEC   .060480472     (COS76)/4
0730                      14,2508   35137 1
0731                      14,2507   73003 0  CSS6640  2DEC   -.15802587     (COS78 - COS30)/4
0731                      14,2510   65403 0
0732                      14,2511   06233 0  CSS33    2DEC   .197002688     COS(1/2(78))/4
0732                      14,2512   26112 1
0733                      14,2513   77414 0  PICEND   BOFF   EXIT
0734  REP  4  LAST  709   14,2514   01745 0                    VFLAG
0735  REP  1             14,2515   30517 1                    PICOXT
0736  REP  1             14,2516   0 2521 0         TC       PICBXT
0737                      14,2517    77776 1 PICOXT  EXIT
0738  REP  4  LAST  707   14,2520   25777 1          INCR     QMIN
0739  REP  5  LAST  710   14,2521   3 1777 1 PICBXT  CA       QMIN
0740  REP  3  LAST  413   14,2522   0 4581 1         TC       SWCALL
A0741                                  V1       =      12D
```

```
P0742  NAME-R51  FINE ALIGN
R0743  FUNCTION-TO ALIGN THE STABLE MEMBER TO REFSMMAT
R0744  CALLING SEQ- CALL  R51
R0745  INPUT- BESTI,BESTJ(PAIR OF STAR NO )
R0746  OUTPUT- GYRO TORQUE PULSES
R0747  SUBROUTINES- R52,R54,R55(SXTNB,NBSM,AXISGEN
 0748  REF   1                                    COUNT  14/R51

 0749                        14,2523   77776 1  R51     EXIT
 0750  REF  55  LAST  695    14,2524   3 4712 1          CAF    BIT1
 0751  REF   4  LAST  610    14,2525   54 304 1          TS     STARIND
 0752  REF   6  LAST  610    14,2526   54 301 1          TS     MARKINDX
 0753  REF 169  LAST  707    14,2527   0 6006 1  R51.2   TC     INTPRET
 0754                        14,2530    43014 0  R51.3   CLEAR  CLEAR
 0755  REF   3  LAST  610    14,2531    00666 1          TARG2FLG
 0756  REF   5  LAST  699    14,2532    00665 1          TARG1FLG
 0757                        14,2533    77776 1          EXIT
 0758  REF  65  LAST  695    14,2534   0 5301 0          TC     PHASCHNG
 0759                        14,2535    05024 1          OCT    05024          RESTART GR 4 FOR R52 - R53
 0760                        14,2536    13000 0          OCT    13000
 0761  REF   5  LAST  711    14,2537   50 304 0          INDEX  STARIND
 0762  REF  11  LAST  709    14,2540   3 0302 0          CA     BESTI
 0763                        14,2541   0 0006 1          EXTEND
 0764  REF   1               14,2542   7 2701 1          MP     1/6TH
 0765  REF   6  LAST  611    14,2543   54 735 1          TS     STARCODE
 0766  REF   1               14,2544   3 2700 1          CAF    V01N70
 0767  REF 166  LAST  701    14,2545   0 4555 0          TC     BANKCALL
 0768  REF  15  LAST  661    14,2546    20763 1          CADR   GOFLASHR
 0769  REF  50  LAST  702    14,2547   0 4106 1          TC     GOTOPOOH
 0770                        14,2550   0 2555 0          TC     +5
 0771                        14,2551   0 2544 0          TC     -5
 0772  REF  24  LAST  649    14,2552   3 6211 0          CAF    SIX
 0773  REF  13  LAST  617    14,2553   0 5415 1          TC     BLANKET
 0774  REF  94  LAST  701    14,2554   1 5112 1          TCF    ENDOFJOB
 0775  REF 170  LAST  711    14,2555   0 6006 1          TC     INTPRET
 0776                        14,2556    45034 1          RTB    CALL
 0777  REF  20  LAST  696    14,2557    45505 0                 LOADTIME
 0778  REF   1               14,2560    32363 0                 PLANET
 0779                        14,2561    72131 1          SSP    LXA,1
 0780  REF  26  LAST  708    14,2562    00051 0                 S1
 0781                        14,2563    00000 1                 0
 0782  REF   6  LAST  711    14,2564    00304 0                 STARIND
 0783                        14,2565    77700 0          TIX,1
 0784  REF   1               14,2566    30571 1                 R51ST
 0785  REF   3  LAST  611    14,2567    36617 1          STCALL STARSAV2       2ND STAR
 0786  REF   2  LAST  711    14,2570    30572 1                 R51ST +1
 0787  REF   2  LAST   91    14,2571    02611 0  R51ST  STORE  STARSAV1        1ST STAR
 0788                        14,2572    77776 1          EXIT
 0789  REF  12  LAST  644    14,2573   4 1011 1          CS     MODREG         IS THIS P54
 0790  REF   1               14,2574   6 2677 0          AD     OCT66
```

```
0791
0792  REP   1
0793  REP 171  LAST  711
0794
0795  REP   4  LAST  613
0796
0797  REP   1
0798  REP   4  LAST  711
0799
0800  REP 169  LAST  711
0801  REP   7  LAST  701
0802  REP 172  LAST  712
0803
0804  REP   9  LAST  704
0805  REP   2  LAST  711
0806
0807  REP   7  LAST  711
0808  REP   1
0809  REP 173  LAST  712
0810
0811  REP  22  LAST  708
0812  REP   5  LAST  443
0818
0819  REP   5  LAST  712
0820
0821  REP   3  LAST  711
0822
0823  REP   2  LAST   91
0824  REP   6  LAST  712
0825  REP   1
0826
0827  REP   1
0828  REP   1
0829  REP   2  LAST  444
0830
0831  REP   1
0832
0833  REP   2  LAST  640
0834
0835  REP   2  LAST  155
0836  REP 190  LAST  712
0837  REP   4  LAST  696
0838  REP  51  LAST  711
0839
0840
0841  REP 191  LAST  712
0842  REP   3  LAST  697
0843  REP 174  LAST  712
0844
0845  REP   1

14,2575  0 0008 1          EXTEND
14,2576  1 2672 1          BZF   R51B          YES
14,2577  0 8008 1          TC    INTPRET
14,2600   77624 1          CALL
14,2601   30002 0                R52           AOP WILL MAKE CALLS TO SIGHTING
14,2602   77824 1  R51A    CALL                COMPUTE LOS IN S4 FROM MARK DATA
14,2603   31288 1                SXTSM
14,2604   02817 0          STORE STARSAV2
14,2605   77776 1          EXIT
14,2606  0 4555 0          TC    BANKCALL
14,2607   16063 0          CADR  MKRELEAS
14,2610  0 6008 1          TC    INTPRET
14,2611   45145 0          DLOAD CALL
14,2612   02607 1                TSIGHT
14,2613   32383 0                PLANET
14,2614   77778 1          EXIT
14,2615   10 304 1         CCS   STARIND
14,2616  0 2657 1          TC    R51.4
14,2617  0 8006 1          TC    INTPRET
14,2620   53521 1          MXV   UNIT
14,2621   01736 1                REFSMMAT
14,2622   02738 1          STORE STARAD
14,2623   77775 1          VLOAD
14,2624   02817 0                STARSAV2
14,2625   24007 0          STOVL 6D
14,2626   02611 0                STARSAV1
14,2627   24015 0          STOVL 12D
14,2630   02801 1                PLANVEC
14,2631   36744 0          STCALL STARAD +6
14,2632   30702 1                R54           STAR DATA TEST
14,2633   45014 0          BOFF  CALL
14,2634   00354 0                FREEFLAG
14,2635   30843 0                R51K
14,2636   47334 0                AXISGEN
14,2637   77824 1          CALL
14,2640   32203 1                R55           GYRO TORQUE
14,2641   77614 1          CLEAR
14,2642   01273 0                PPRATFLG
14,2643   77776 1  R51K    EXIT
14,2644  3 5858 1          CAF   OCT14
14,2645  0 4555 0          TC    BANKCALL
14,2646   20751 0          CADR  GOPERF1
14,2647  0 4106 1          TC    GOTOPOOH
14,2650  0 2652 1          TC    +2            V33
14,2651  0 2654 1          TC    +3
14,2652  0 4555 0          TC    BANKCALL
14,2653   32120 0          CADR  P52C
14,2654  0 6006 1          TC    INTPRET
14,2655   77650 1          GOTO
14,2656   32143 0                ENDP50S
```

```
0846  REP 175  LAST  712   14,2657  0 6006 1  R51.4   TC      INTPRET
0847                       14,2660   53521 1           MXV     UNIT
0848  REP  23  LAST  712   14,2661   01738 1                   REFSMMAT
0849  REP   3  LAST  712   14,2662   28601 1           STOVL   PLANVEC
0850  REP   6  LAST  712   14,2663   02617 0                   STARSAV2
0851  REP   4  LAST  712   14,2664   02611 0           STORE   STARSAV1
0852                       14,2665   77731 1           SSP
0853  REP   8  LAST  712   14,2666   00305 1                   STARIND
0854                       14,2667   00000 1                   0
0855                       14,2670   77850 1           GOTO
0856  REP   1              14,2671   30530 1                   R51.3
0857  REP 178  LAST  713   14,2672  0 8008 1  R51B    TC      INTPRET
0858                       14,2673   77624 1           CALL
0859  REP   1              14,2674   32252 0                   R56
0860                       14,2675   77650 1           GOTO
0861  REP   1              14,2676   30602 0                   R51A
0862                       14,2677   00088 1  CCT86    CCT     00086
0863                       14,2700   00306 1  V01N70   VN      0170
0884                       14,2701   05253 0  1/6TH    DEC     .1666667
```

L P51-P53

```
P0865  NAME-R55  GYRO TORQUE
R0866  FUNCTION-COMPUTE AND SEND GYRO PULSES
R0867  CALLING SEQ- CALL R55
R0868  INPUT- X,Y,ZDC- REFSMMAT WRT PRESENT STABLE MEMBER
R0869  OUTPUT- GYRO PULSES
R0870  SUBROUTINES- CALCGTA,GOFLASH,GODSPR,IMUFINE,IMUPULSE,GOPERF1
 00705  BNK   3  LAST  705   15,2000                          SETLOC P50S
 0871                        15,2203                          BANK
 00715  BNK   1                                              COUNT* $$/R55
 0872                        15,2203   77620 0  R55          STQ
 0873  BNK   6  LAST  710    15,2204   02777 1                QMIN
 0874                        15,2205   77624 1               CALL
 0875  BNK   3  LAST  534    15,2206   47140 1                CALCGTA
 0876                        15,2207   77776 1  PULSEM       EXIT
 0877  BNK   1               15,2210   3 2234 0 R55.1        CAP   V06N93
 0878  BNK 192  LAST  712    15,2211   0 4555 0              TC    BANKCALL
 0879  BNK  32  LAST  698    15,2212    20624 0              CADR  GOFLASH
 0880  BNK  52  LAST  712    15,2213   0 4106 1              TC    GOTOPOOH
 0881  BNK   1               15,2214   0 2216 0              TC    R55.2
 0882  BNK   1               15,2215   0 2231 0              TC    R55RET
 0883  BNK  66  LAST  711    15,2216   0 5301 0 R55.2        TC    PHASCHNG
 0884                        15,2217    00314 1             OCT   00314
 0885  BNK   1               15,2220   3 2235 1              CA    R55CDR
 0886  BNK 193  LAST  714    15,2221   0 4555 0              TC    BANKCALL
 0887  BNK   5  LAST  439    15,2222    17125 1              CADR  IMUPULSE
 0888  BNK 194  LAST  714    15,2223   0 4555 0              TC    BANKCALL
 0889  BNK   8  LAST  439    15,2224    17516 0              CADR  IMUSTALL
 0890  BNK   1               15,2225   0 5644 1              TC    CURTAINS
 0891  BNK  67  LAST  714    15,2226   0 5301 0              TC    PHASCHNG
 0892                        15,2227    05024 1             OCT   05024
 0893                        15,2230    13000 0             OCT   13000
 0894  BNK 177  LAST  713    15,2231   0 6006 1 R55RET       TC    INTPRET
 0895                        15,2232    77650 1              GOTO
 0896  BNK   7  LAST  714    15,2233    02777 1                QMIN
 0897                        15,2234    01535 0 V06N93       VN    0893
 0898  BNK  16  LAST  535    15,2235    02757 0 R55CDR       ECADR CGC
 0899  BNK   1               14,2702             R54        =     CHKSDATA
R0900  ROUTINE NAME- CHKSDATA
R0902  MOD NO- 0                                              DATE- JAN 9, 1967
R0904  MODIFICATION BY- LONSKE                                LOG SECTION- P51-P53
                                                              ASSEMBLY-

R0906  FUNCTIONAL DESCRIPTION - CHECKS THE VALIDITY OF A PAIR OF STAR SIGHTINGS. WHEN A PAIR OF STAR SIGHTINGS ARE MADE
R0908  BY THE ASTRONAUT THIS ROUTINE OPERATES AND CHECKS THE OBSERVED SIGHTINGS AGAINST STORED STAR VECTORS IN THE
R0910  COMPUTER TO INSURE A PROPER SIGHTING WAS MADE. THE FOLLOWING COMPUTATIONS ARE PERFORMED

R0912                  OS1 = OBSERVED STAR 1 VECTOR
R0913                  OS2 = OBSERVED STAR 2 VECTOR
R0914                  SS1 = STORED STAR 1 VECTOR
R0915                  SS2 = STORED STAR 2 VECTOR
R0916                   A1 = ARCCOS(OS1 - OS2)
```

```
R0917                    A2 = ARCCOS(SS1 - SS2)
R0918                    A  = ABS(2(A1 - A2))

R0919   THE ANGULAR DIFFERENCE IS DISPLAYED FOR ASTRONAUT ACCEPTENCE
R0920   EXIT MODE 1. FREEFLAG SET  IMPLIES  ASTRONAUT WANTS TO PROCEED
R0921              2. FREEFLAG RESET IMPLIES ASTRONAUT WANTS TO RECYCLE          ERANCE)
R0923   OUTPUT - 1.VERB 6,NOUN 3- DISPLAYS ANGULAR DIFFERENCE BETWEEN 2 SETS OF STARS.
R0925            2.STAR VECTORS FROM STAR CATALOG ARE LEFT IN 6D AND 12D.

R0926   ERASABLE INITIALIZATION REQUIRED -
R0927            1.MARK VECTORS ARE STORED IN STARAD AND STARAD +6.
R0928            2.CATALOG VECTORS ARE STORED IN 6D AND 12D.
R0929   DEBRIS -
 09295  REF   4  LAST  707   14,2000                          SETLOC  P50S1
  0930                        14,2702                          BANK
 09305  REF   1                                              COUNT*  $$/R50
  0931                        14,2702   43020 1  CHKSDATA    STQ     SET
  0932  REF   6  LAST  714   14,2703   02777 1                  QMIN
  0933  REF   2  LAST  712   14,2704   00074 1                  FREEFLAG
  0934                        14,2705   77760 0  CHKSAB      AXC,1                   SET X1 TO STORE  EPHEMERIS DATA
  0935  REF   7  LAST  712   14,2706   02735 1                  STARAD
R0936
  0937                        14,2707   47773 1  CHKSB       VLOAD*  DOT*           CAL. ANGLE THETA
  0938                        14,2710   00001 0                  0,1
  0939                        14,2711   00007 0                  6,1
  0940                        14,2712   65552 0                  SL1     ACOS
  0941  REF   1              14,2713   00025 0                  STORE   THETA
  0942                        14,2714   43014 0                  BOFF    INVERT          BRANCH TO CHKSD IF THIS IS 2ND PASS
  0943  REF   3  LAST  715   14,2715   00354 0                  FREEFLAG
  0944  REF   1              14,2716   30726 1                  CHKSD
  0945  REF   4  LAST  715   14,2717   00174 0                  FREEFLAG        CLEAR FREEFLAG
  0946                        14,2720   71360 1                  AXC,1   DLOAD    SET X1 TO MARK ANGLES
  0947                        14,2721   00006 1                  6D
  0948  REF   2  LAST  715   14,2722   00025 0                  THETA
  0949                        14,2723   00023 0                  STORE   18D
  0950                        14,2724   77650 1                  GOTO
  0951  REF   1              14,2725   30707 1                  CHKSB           RETURN TO CAL. 2ND ANGLE
  0952                        14,2726   45345 1  CHKSD       DLOAD   DSU
  0953  REF   3  LAST  715   14,2727   00025 0                  THETA
  0954                        14,2730   00023 0                  18D             COMPUTE POS DIFF
  0955                        14,2731   47046 0                  ABS     RTB
  0956  REF   3  LAST  495   14,2732   45541 0                  SGNAGREE
  0957  REF   1              14,2733   01046 1                  STORE   NORMTEM1
  0958                        14,2734   77414 0                  SET     EXIT
  0959  REF   5  LAST  715   14,2735   00074 1                  FREEFLAG
 09594  REF 144  LAST  701   14,2736   3 4714 1                 CAF     ZERO
 09595  REF 195  LAST  714   14,2737   0 4555 0                 TC      BANKCALL
 09596  REF   5  LAST  642   14,2740    20607 1                 CADR    CLEANDSP

  0960  REF   1              14,2741   3 2755 1                 CAF     VB6N5
```

```
 0961   REF 196  LAST  715    14,2742   0 4555 0            TC      BANKCALL
 0962   REF  33  LAST  714    14,2743    20624 0            CADR    GOFLASH
 0963   REF  53  LAST  714    14,2744   1 4106 0            TCF     GOTOPOOH
 0964   REF   1              14,2745   0 2752 0            TC      CHKSDA          PROCEED
 0965   REF 178  LAST  714    14,2746   0 6006 1            TC      INTPRET
 0966                        14,2747    52014 0            CLEAR   GOTO
 0967   REF   6  LAST  715    14,2750    00274 0                    PREFLAG
 0968   REF   9  LAST  715    14,2751    02777 1                    QMIN
 0969   REF 179  LAST  716    14,2752   0 6006 1  CHKSDA    TC      INTPRET
 0970                        14,2753    77650 1            GOTO
 0971   REF  10  LAST  716    14,2754    02777 1                    QMIN
 0972                        14,2755    01405 1  VB6N5     VN      605
R0973   NAME - CAL53A
R0974   NAME - CAL53A
R0975   FUNCTION - COARSE ALIGN THE IMU, IF NECESSARY.
R0976   CALLING SEQUENCE - CALL CAL53A
R0977   INPUT -  PRESENT GIMBAL ANGLES - CDUX,CDUY,CDUZ
R0978            DESIRED GIMBAL ANGLES - THETAD,+1,+2
R0979   OUTPUT - THE IMU COORDINATES ARE STORED IN REFSMMAT
R0980   SUBROUTINES USED - 1.IMUCOARS 2.IMUSTALL 3.CURTAINS
 0981   REF   2 LAST  715 TO  716'     44     44*          COUNT   14/R50

 0982                       14,2756    45020 1  CAL53A    STQ     CALL
 0983                       14,2757    00035 1                    29D
 0984   REF   2  LAST  696   14,2760    22256 0                    S52.2           MAKE FINAL COMP OF GIMBAL ANGLES
 0985                       14,2761    66234 1            RTB     SSP
 0986   REF   1             14,2762    32236 1                    RDCDUS          READ CDUS
 0987   REF  27  LAST  711   14,2763    00051 0                    S1
 0988                       14,2764    00001 0                    1
 0989                       14,2765    40370 1            AXT,1   SETPD
 0990                       14,2766    00003 1                    3
 0991                       14,2767    00005 1                    4
 0992                       14,2770    70543 1  CALOOP    DLOAD*  SR1
 0993   REF  16  LAST  587   14,2771    01161 0                    THETAD +3D,1
 0994                       14,2772    70523 1            PDDL*   SR1
 0995                       14,2773    00005 1                    4,1
 0996                       14,2774    51425 0            DSU     ABS
 0997                       14,2775    45206 1            PUSH    DSU
 0998   REF   1             14,2776    31053 0                    DEGREE1
 0999                       14,2777    71240 1            BMN     DLOAD
 1000   REF   1             14,3000    31027 0                    CALOOP1
 1001                       14,3001    51025 1            DSU     BPL
 1002   REF   1             14,3002    31054 1                    DEG359
 1003   REF   2  LAST  716   14,3003    31027 0                    CALOOP1
 1004                       14,3004    77776 1  COARFINE  EXIT
 1005   REF 197  LAST  716   14,3005   0 4555 0            TC      BANKCALL
 1006   REF   4  LAST  421   14,3006    16602 1            CADR    IMUCOARS        PERFORM COARSE ALIGNMENT
 1007   REF 198  LAST  716   14,3007   0 4555 0            TC      BANKCALL
 1008   REF   9  LAST  714   14,3010    17516 0            CADR    IMUSTALL        REQUEST MODE SWITCH
 1009   REF   2  LAST  714   14,3011   0 5644 1            TC      CURTAINS
```

```
1010  REF 199  LAST  716   14,3012  0 4555 0          TC      BANKCALL
1011  REF   1              14,3013   17012 1          CADR    IMUPIN20
1012  REF 200  LAST  717   14,3014  0 4555 0          TC      BANKCALL
1013  REF  10  LAST  716   14,3015   17516 0          CADR    IMUSTALL
1014  REF   3  LAST  716   14,3016  0 5644 1          TC      CURTAINS     TEST FOR MALFUNCTION
1015  REF 180  LAST  718   14,3017  0 6006 1          TC      INTPRET
1016                        14,3020   77234 1          RTB     VLOAD
1017  REF   1              14,3021   31263 1                  SET1/PDT
1018  REF   3  LAST  460   14,3022   11456 0                  ZEROVEC
1019  REF  18  LAST  427   14,3023   01472 1          STORE   GCOMP
1020                        14,3024   52014 0          SET     GOTO
1021  REF   1              14,3025   01060 0                  DRIFTFLG
1022  REF   1              14,3026   31031 1                  PINEONLY
1023                        14,3027   77700 0  CALOOP1 TIX,1
1024  REF   1              14,3030   30770 1                  CALOOP
1025                        14,3031   75160 1  PINEONLY AXC,1  AXC,2
1026  REF  31  LAST  526   14,3032   02671 0                  XSM
1027  REF  24  LAST  713   14,3033   01735 1                  REFSMMAT
1028                        14,3034   77624 1          CALL
1029  REF   1              14,3035   31040 1                  MATMOVE
1030                        14,3036   77650 1          GOTO
1031                        14,3037   00035 1                  29D
1032                        14,3040   77773 1  MATMOVE VLOAD*               TRANSFER MATRIX
1033                        14,3041   00001 0                  0,1
1034                        14,3042   10001 1          STORE   0,2
1035                        14,3043   77773 1          VLOAD*
1036                        14,3044   00007 0                  6D,1
1037                        14,3045   10007 1          STORE   6D,2
1038                        14,3046   77773 1          VLOAD*
1039                        14,3047   00015 0                  12D,1
1040                        14,3050   10015 1          STORE   12D,2
1041                        14,3051   77616 0          RVQ
1042                        14,3052   00056 1  DEGREE1 DEC     46
1043                        14,3053   37722 1  DEG359  DEC     16338
1044  REF   4  LAST  714   15,2000                    SETLOC  P50S
1045                        15,2236                    BANK
1046                        15,2236  0 0004 0  RDCDUS  INHINT               READ CDUS
1047  REF  16  LAST  661    15,2237  3 0032 0          CA      CDUX
1048  REF  12  LAST  586    15,2240  50 120 1          INDEX   FIXLOC
1049                        15,2241  54 001 1          TS      1
1050  REF   7  LAST  661    15,2242  3 0033 1          CA      CDUY
1051  REF  13  LAST  717    15,2243  50 120 1          INDEX   FIXLOC
1052                        15,2244  54 002 1          TS      2
1053  REF  10  LAST  661    15,2245  3 0034 0          CA      CDUZ
1054  REF  14  LAST  717    15,2246  50 120 1          INDEX   FIXLOC
1055                        15,2247  54 003 0          TS      3
1056                        15,2250  0 0003 1          RELINT
1057  REF   5  LAST  537    15,2251  0 6030 1          TC      DANZIG
R1058  NAME - GIMB
R1059  FUNCTION - DETERMINE AND COMPUTE THE DESIRED GIMBAL ANGLES TO BE USED          FOR COARSE ALIGNMENT.
```

L P51-P53

```
R1061   CALLING SEQUENCE - CALL GIMB
R1062   INPUT - DESIRED IMU INERTIAL ORIENTATION VECTORS-XSMD,YSMD,ZSMD
R1063   OUTPUT - GIMBAL ANGLES LEFT IN THETAD,+1,+2
R1064   SUBROUTINES USED - 1.CDUTRIG 2.CALCSMSC 3.CALCGA
 1065   REF   2  LAST  697   16,2000                        SETLOC  P50S2
 1066                        16,2567                        BANK
 1067   REF   1                                            COUNT   14/INFLT

 1068                        16,2567   41345 0  CALCSMSC  DLOAD   DMP
 1069   REF   1              16,2570   00737 1            SINCDUY
 1070   REF   2  LAST  535   16,2571   00747 0            COSCDUZ
 1071                        16,2572   77676 0            DCOMP
 1072                        16,2573   70525 1            PDDL    SR1
 1073   REF   2  LAST  535   16,2574   00741 0            SINCDUZ
 1074                        16,2575   41325 0            PDDL    DMP
 1075   REF   1              16,2576   00745 1            COSCDUY
 1076   REF   3  LAST  716   16,2577   00747 0            COSCDUZ
 1077                        16,2600   76466 1            VDEF    VSL1
 1078   REF   5  LAST  706   16,2601   02714 1            STORE   XNB
 1079                        16,2602   41345 0            DLOAD   DMP
 1080   REF   3  LAST  535   16,2603   00743 1            SINCDUX
 1081   REF   3  LAST  716   16,2604   00741 0            SINCDUZ
 1082                        16,2605   77752 1            SL1
 1083                        16,2606   00033 1            STORE   26D
 1084                        16,2607   77605 1            DMP
 1085   REF   2  LAST  716   16,2610   00737 1            SINCDUY
 1086                        16,2611   41325 0            PDDL    DMP
 1087   REF   3  LAST  535   16,2612   00751 1            COSCDUX
 1088   REF   2  LAST  716   16,2613   00745 1            COSCDUY
 1089                        16,2614   77625 0            DSU
 1090                        16,2615   41325 0            PDDL    DMP
 1091   REF   4  LAST  716   16,2616   00743 1            SINCDUX
 1092   REF   4  LAST  716   16,2617   00747 0            COSCDUZ
 1093                        16,2620   77676 0            DCOMP
 1094                        16,2621   41325 0            PDDL    DMP
 1095   REF   4  LAST  716   16,2622   00751 1            COSCDUX
 1096   REF   3  LAST  716   16,2623   00737 1            SINCDUY
 1097                        16,2624   41325 0            PDDL    DMP
 1098   REF   3  LAST  716   16,2625   00745 1            COSCDUY
 1099                        16,2626   00033 1            26D
 1100                        16,2627   55415 1            DAD     VDEF
 1101                        16,2630   77772 0            VSL1
 1102   REF   5  LAST  706   16,2631   02730 1            STORE   ZNB
 1103                        16,2632   76435 1            VXV     VSL1
 1104   REF   6  LAST  716   16,2633   02714 1                    XNB
 1105   REF   4  LAST  417   16,2634   02722 1            STORE   YNB
 1106                        16,2635   77616 0            RVQ
R1107   NAME - P51 - IMU ORIENTATION DETERMINATION
R1108   MOD.NO.2  21 DEC 66
R1110   MOD BY STURLAUGSON
```

R1112 FUNCTIONAL DESCRIPTION

R1113 DETERMINES THE INERTIAL ORIENTATION OF THE IMU. THE PROGRAM IS SELECTED BY DSKY ENTRY. THE SIGHTING
R1115 ROUTINE IS CALLED TO COLLECT THE CDU COUNTERS AND SHAFT AND TRUNNION ANGLES FOR A SIGHTED STAR. THE DATA IS
R1117 THEN PROCESSED AS FOLLOWS.

R1118 1. SEXTANT ANGLES ARE COMPUTED IN TERMS OF NAVIGATIONAL BASE COORDINATES. LET SA AND TA BE THE SHAFT AND
R1120 TRUNNION ANGLES, RESPECTIVELY. THEN,

R1121
R1122 $\vec{V}_{NB} = (SIN(TA)*COS(SA),\ SIN(TA)*SIN(SA),\ COS(TA))$ (A COLUMN VECTOR)
R1124
R1125 THE OUTPUT IS A HALF-UNIT VECTOR STORED IN STARM.

R1126 2. THIS VECTOR IN NAV.BASE COORDS. IS THEN TRANSFORMED TO ONE IN STABLE MEMBER COORDINATES.

R1128
R1129 $\vec{V} = Q_1 * Q_2 * Q_3 * \vec{V}_{NB}$, WHERE
R1130

R1131
R1132
R1134 $Q_1 = \begin{pmatrix} \cos(IG) & 0 & -\sin(IG) \\ 0 & 1 & 0 \\ \sin(IG) & 0 & \cos(IG) \end{pmatrix}$, IG=INNER GIMBAL ANGLE
R1136
R1138

THE GIMBAL ANGLES ARE COMPUTED FROM THE CDU COUNTERS AT NBSM (USING AXIS-ROT AND CDULOGIC)

R1139
R1140
R1141
R1142 $Q_2 = \begin{pmatrix} \cos(MG) & \sin(MG) & 0 \\ -\sin(MG) & \cos(MG) & 0 \\ 0 & 0 & 1 \end{pmatrix}$, MG=MIDDLE GIMBAL ANGLE
R1143
R1144

R1145
R1146
R1147
R1148 $Q_3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos(OG) & \sin(OG) \\ 0 & -\sin(OG) & \cos(OG) \end{pmatrix}$, OG=OUTER GIMBAL ANGLE
R1149
R1150

R1151 3. THE STAR NUMBER IS SAVED AND THE SECOND STAR IS THEN SIMILARLY PROCESSED.

R1153 4. THE ANGLE BETWEEN THE TWO STARS IS THEN CHECKED AT CKSDATA.

R1154 5. REFSMMAT IS THEN COMPUTED AT AXISGEN AS FOLLOWS.
R1155
R1158 LET $\vec{S}_1$ AND $\vec{S}_2$ BE TWO STAR VECTORS EXPRESSED IN TWO COORDINATE SYSTEMS,A AND B (BASIC AND STABLE MEMBER).
R1158

R1159 DEFINE,

```
R1160              U  = S
R1161               A    A1

R1162              -          -    -
R1163              V  = UNIT(S  X S  )
R1164               A          A1   A2

R1165              -    -    -
R1166              W = U X V
R1167               A    A    A
R1168        AND
R1169              -    -
R1170              U  = S
R1171               B    B1

R1172              -          -    -
R1173              V  = UNIT(S  X S  )
R1174               B          B1   B2

R1175              -    -    -
R1176              W  = U X V
R1177               B    B    B

R1178        THEN  -          -          -          -
R1179              X  = U  *U + V  *V + W  *W
R1180                    B1  A    B1  A    B1  A

R1181              -          -          -          -                (REFSMMAT)
R1182              Y  = U  *U + V  *V + W  *W
R1183                    B2  A    B2  A    B2  A

R1184              -          -          -          -
R1185              Z  = U  *U + V  *V + W  *W
R1186                    B3  A    B3  A    B3  A

R1187        THE INPUTS CONSIST OF THE FOUR HALF-UNIT VECTORS STORED AS FOLLOWS

R1188              -
R1189              S   IN 6-11 OF THE VAC AREA
R1190               A1

R1191              -
R1192              S   IN 12-17 OF THE VAC AREA
R1193               A2

R1194              -
R1195              S   IN STARAD
R1196               B1

R1197              -
```

R1198 S IN STARAD +6
R1199 B_2

R1200 CALLING SEQUENCE

R1201 THE PROGRAM IS CALLED BY THE ASTRONAUT BY DSKY ENTRY.

R1202 SUBROUTINES CALLED.

R1203 GOPERF$_3$
R1204 GOPERF$_{1R}$
R1205 GODSPR
R1206 IMUCOARS
R1207 IMUPIN$_{20}$
R1208 R53
R1209 SXTNB
R1210 NBSM
R1211 MKRELEAS
R1212 CHKSDATA
R1213 MATMOVE

R1214 ALARMS

R1215 NONE.
R1216 ERASABLE INITIALIZATION

R1217 IMU ZERO FLAG SHOULD BE SET.

R1218 OUTPUT

R1219 REFSMMAT
R1220 REFSMFLG

R1221 DEBRIS

R1222 WORK AREA
R1223 STARAD
R1224 STARIND
R1225 BESTI
R1226 BESTJ

```
1227  REF   5  LAST  715   14,2000                        SETLOC  P50S1
1228                       14,3054                        BANK
1229  REF   1                                            COUNT   14/P5153

1230  REF   2  LAST  200   14,3054            P53         EQUALS  P51
1231  REF  42  LAST  381   14,3054  4 1320 0  P51         CS      IMODES30
1232  REF  26  LAST  690   14,3055  7 4702 1              MASK    BIT9
1233  REF 175  LAST  701   14,3056  10 000 0              CCS     A
1234  REF   1               14,3057  0 3063 1              TC      P51A
```

```
1235  REP  29  LAST  700    14,3060  0 5537 0          TC     ALARM
1236                        14,3061   00210 1          OCT    210.
1237  REP  54  LAST  716    14,3062  0 4106 1          TC     GOTOPOOH
1238  REP 201  LAST  717    14,3063  0 4555 0  P51A    TC     BANKCALL
1239  REP   1                14,3064   17607 0          CADR   R02ZERO

1240  REP   1                14,3065  3 4720 0  P51AA   CAF    PRFMSTAQ
1241  REP 202  LAST  722    14,3066  0 4555 0          TC     BANKCALL
1242  REP   5  LAST  712    14,3067   20751 0          CADR   GOPERF1
1243  REP  55  LAST  722    14,3070  0 4106 1          TC     GOTOPOOH
1244  REP   1                14,3071  0 3134 1          TC     P51B
1245  REP  66  LAST  714    14,3072  0 5301 0          TC     PHASCHNG
1246                        14,3073   05024 1          OCT    05024
1247                        14,3074   13000 0          OCT    13000
1246  REP   1                14,3075  3 4714 1          CAF    P51ZERO
1249  REP  17  LAST  716    14,3076  55∝155 0          TS     THETAD
1250  REP  18  LAST  722    14,3077  55∝156 0          TS     THETAD +1
1251  REP  19  LAST  722    14,3100  55∝157 1          TS     THETAD +2
1252  REP   1                14,3101  3 3261 1          CAF    V6N22
1253  REP 203  LAST  722    14,3102  0 4555 0          TC     BANKCALL
1254  REP   2  LAST  442    14,3103   20577 0          CADR   GODSPRET
1255  REP   1                14,3104  3 3262 1          CAF    V41K
1256  REP 204  LAST  722    14,3105  0 4555 0          TC     BANKCALL
1257  REP   3  LAST  722    14,3106   20577 0          CADR   GODSPRET
1258  REP 205  LAST  722    14,3107  0 4555 0          TC     BANKCALL
1259  REP   5  LAST  716    14,3110   16602 1          CADR   IMUCOARS
1260  REP 206  LAST  722    14,3111  0 4555 0          TC     BANKCALL
1261  REP  11  LAST  717    14,3112   17516 0          CADR   IMUSTALL
1262  REP   4  LAST  717    14,3113  0 5644 1          TC     CURTAINS
1263  REP 207  LAST  722    14,3114  0 4555 0          TC     BANKCALL
1264  REP   2  LAST  717    14,3115   17012 1          CADR   IMUFIN20
1265  REP 206  LAST  722    14,3116  0 4555 0          TC     BANKCALL
1266  REP  12  LAST  722    14,3117   17516 0          CADR   IMUSTALL
1267  REP   5  LAST  722    14,3120  0 5644 1          TC     CURTAINS
1268  REP 161  LAST  717    14,3121  0 6006 1          TC     INTPRET
1269                        14,3122   77234 1          RTB    VLOAD
1270  REP   2  LAST  717    14,3123   31263 1                 SET1/PDT
1271  REP   4  LAST  717    14,3124   11456 0                 ZEROVEC
1272  REP  19  LAST  717    14,3125   01472 1          STORE  GCOMP
1273                        14,3126   77414 0          SET    EXIT
1274  REP   2  LAST  717    14,3127   01060 0                 DRIFTFLG
1275  REP  69  LAST  722    14,3130  0 5301 0          TC     PHASCHNG
1276                        14,3131   05024 1          OCT    05024
1277                        14,3132   13000 0          OCT    13000
1278  REP   1                14,3133  1 3065 0          TCF    P51AA
```

TERM.
V 33

ZERO THE GIMBALS

NOW DISPLAY COARSE ALIGN VERB 41

CAGING OR BAD END
SCHEDULE IPAILOK AND IMUFINED TASKS, IN 5 AND 20 SECS. DIRECT RETURN AND NO STALL, IF CAGING, BUT T4 WILL ZERO C/A ENABLE. IF PUT TO SLEEP, IMUFINED WILL WAKE US UP.

COARSE ALIGN DONE - RECYCLE FOR FINE

P1279 DO STAR SIGHTING AND COMPUTE NEW REFSMMAT

```
1280  REF  70  LAST  722   14,3134   0 5301 0   P51B    TC      PHASCHNG
1281                       14,3135    00014 1           OCT     00014
1282  REF 182  LAST  722   14,3136   0 6006 1           TC      INTPRET
1283                       14,3137    40331 1           SSP     SETPD
1284  REF   9  LAST  713   14,3140    00305 1                   STARIND     INDEX-STAR 1 OR 2
1285                       14,3141    00000 1                   0
1286                       14,3142    00001 0                   0
1287                       14,3143    77414 0           CLEAR   EXIT
1288  REF   4  LAST  711   14,3144    00666 1                   TARG2FLG    SHOW STAR MARK-NOT LAND MARK
1289  REF  56  LAST  711   14,3145    3 4712 1          CAF     BIT1
1290  REF   7  LAST  711   14,3146    54 301 1          TS      MARKINDX    INITIALIZE FOR ONE MARK

1291  REF  71  LAST  723   14,3147   0 5301 0   P51C    TC      PHASCHNG
1292                       14,3150    05024 1           OCT     05024
1293                       14,3151    13000 0           OCT     13000
1294  REF  10  LAST  511   14,3152   0 5253 0           TC      CHECKMM
1295                       14,3153    00065 1           MM      53          BACKUP PROGRAM
1296  REF   1              14,3154    1 3162 0          TCF     P51C.1      NOT P53
1297  REF 183  LAST  723   14,3155   0 6006 1           TC      INTPRET
1298                       14,3156    77624 1           CALL
1299  REF   2  LAST  713   14,3157    32252 0                   R56
1300                       14,3160    77650 1           GOTO
1301  REF   1              14,3161    31165 1                   P51C.2
1302  REF 184  LAST  723   14,3162   0 6006 1   P51C.1  TC      INTPRET
1303                       14,3163    77624 1           CALL
1304  REF   3  LAST  701   14,3164    31322 0                   R53         SIGHTING ROUTINE
1305                       14,3165    77624 1   P51C.2  CALL                COMPUTE LOS IN SM FROM MARK DATA
1306  REF   2  LAST  712   14,3166    31266 1                   SXTSM
1307                       14,3167    77606 1           PUSH
1308                       14,3170    53135 0           SLOAD   BZE
1309  REF  10  LAST  723   14,3171    00305 1                   STARIND
1310  REF   1              14,3172    31177 1                   P51D
1311                       14,3173    45575 1           VLOAD   STADR
1312  REF   7  LAST  713   14,3174    75160 1           STORE   STARSAV2    DOWNLINK
1313                       14,3175    77650 1           GOTO
1314  REF   1              14,3176    31205 1                   P51E
1315                       14,3177    45575 1   P51D    VLOAD   STADR
1316  REF   5  LAST  713   14,3200    61166 1           STODL   STARSAV1
1317  REF  10  LAST  712   14,3201    02607 1                   TSIGHT
1318                       14,3202    77624 1           CALL
1319  REF   3  LAST  712   14,3203    32363 0                   PLANET
1320  REF   4  LAST  713   14,3204    02601 1           STORE   PLANVEC
1321                       14,3205    77776 1   P51E    EXIT
1322  REF  72  LAST  723   14,3206   0 5301 0           TC      PHASCHNG
1323                       14,3207    05024 1           OCT     05024
1324                       14,3210    13000 0           OCT     13000
1325  REF 209  LAST  722   14,3211   0 4555 0           TC      BANKCALL
1326  REF   8  LAST  712   14,3212    16063 0           CADR    MKRELEAS    ZERO MARKSTAT
```

```
1327  REP  11  LAST  723   14,3213  10 304 1            CCS   STARIND
1328  REP   1             14,3214  1 3223 0            TCF   P51P        STAR 2
1329  REP  73  LAST  723   14,3215  0 5301 0            TC    PHASCHNG
1330                       14,3216   05024 1            OCT   05024
1331                       14,3217   13000 0            OCT   13000
1332  REP  57  LAST  723   14,3220  3 4712 1            CAF   BIT1
1333  REP  12  LAST  724   14,3221  54 304 1            TS    STARIND
1334  REP   1             14,3222  1 3147 1            TCF   P51C        GO DO SECOND STAR
1335  REP  74  LAST  724   14,3223  0 5301 0  P51P      TC    PHASCHNG
1336                       14,3224   05024 1            OCT   05024
1337                       14,3225   13000 0            OCT   13000
1338  REP 165  LAST  723   14,3226  0 6006 1            TC    INTPRET
1339                       14,3227   45145 0            DLOAD CALL
1340  REP  11  LAST  723   14,3230   02607 1                  TSIGHT
1341  REP   4  LAST  723   14,3231   32363 0                  PLANET
1342                       14,3232   24015 0            STOVL 12D
1343  REP   5  LAST  723   14,3233   02601 1                  PLANVEC
1344                       14,3234   24007 0            STOVL 6D
1345  REP   6  LAST  723   14,3235   02611 0                  STARSAV1
1346  REP   6  LAST  715   14,3236   26736 1            STOVL STARAD
1347  REP   8  LAST  723   14,3237   02617 0                  STARSAV2
1348  REP   9  LAST  724   14,3240   36744 0            STCALL STARAD +6
1349  REP   2  LAST  714   14,3241   30702 1                  CHKSDATA    CHECK STAR ANGLES IN STARAD AND
1350                       14,3242   77414 0            BON   EXIT
1351  REP   7  LAST  716   14,3243   00314 1                  FREEFLAG
1352  REP   1             14,3244   31246 0                  P51G
1353  REP   2  LAST  722   14,3245  0 3065 1            TC    P51AA
1354                       14,3246   77624 1  P51G      CALL
1355  REP   3  LAST  712   14,3247   47334 0                  AXISGEN     COME BACK WITH REFSMMAT IN XDC
1356                       14,3250   75160 1            AXC,1 AXC,2
1357  REP   4  LAST  534   14,3251   02713 0                  XDC
1358  REP  25  LAST  717   14,3252   01735 1                  REFSMMAT
1359                       14,3253   45014 0            CLEAR CALL
1360  REP   6  LAST  698   14,3254   01662 1                  REFSMFLG
1361  REP   2  LAST  717   14,3255   31040 1                  MATMOVE
1362                       14,3256   52014 0            SET   GOTO
1363  REP   7  LAST  724   14,3257   01462 0                  REFSMFLG
1364  REP   2  LAST  712   14,3260   32143 0                  ENDP50S
1365  REP   3  LAST  697     4720             PRFMSTAQ =     OCT15
1366  REP 145  LAST  715     4714             P51ZERO  =     ZERO
1367  REP  16  LAST  652     4715             P51FIVE  =     FIVE
1368                       14,3261   01426 0  V6N22    VN    0622
1369                       14,3262   12200 0  V41K     VN    4100
1370  REP  13  LAST  659   14,3263  3 0025 0  SET1/PDT CA    TIME1
1371  REP  10  LAST  529   14,3264  55=074 1            TS    1/PIPADT
1372  REP   6  LAST  717   14,3265  1 6030 0            TCF   DANZIG
```

P1373 SXTSM COMPUTES AN LOS VECTOR IN SM COORD FROM OCDU AND ICDU MARK DATA

```
1374                          14,3266  77620 0  SXTSM    STQ
1375  REP   6  LAST  705      14,3267  00300 1                CMAJ
1376                          14,3270  70740 0           LXC,1  DLOAD*
1377  REP  33  LAST  613      14,3271  01330 0                MARKSTAT
1378                          14,3272  00001 0                0D,1
1379  REP  12  LAST  724      14,3273  02607 1           STORE  TSIGHT
1380                          14,3274  66744 0           LXC,2  SLOAD*
1381  REP  13  LAST  724      14,3275  00304 0                STARIND
1382  REP   1                 14,3276  46456 1                MKDNCDR,2
1383                          14,3277  76744 1           LXC,2  VLOAD*
1384  REP 274  LAST  709      14,3300  00154 1                MPAC
1385                          14,3301  00001 0                0,1
1386                          14,3302  10001 1           STORE  0,2
1387                          14,3303  77743 1           DLOAD*
1388                          14,3304  00006 1                5,1
1389                          14,3305  10006 0           STORE  5,2
1390                          14,3306  77624 1           CALL
1391  REP   4  LAST  566      14,3307  46000 0                SXTNB     COMPUTE LOS VECTOR FROM OCDU IN MKVAC
1392                          14,3310  62150 1           LXA,1  INCR,1
1393  REP  34  LAST  725      14,3311  01330 0                MARKSTAT
1394                          14,3312  00002 0                2         INCREMENT TO BASE ADR OF ICDU
1395                          14,3313  45130 1           SXA,1  CALL
1396  REP  28  LAST  716      14,3314  00050 1                S1
1397  REP   2  LAST  566      14,3315  47541 1                NBSM      TRANSFORM LOS TO SM
1398                          14,3316  77650 1           GOTO
1399  REP   7  LAST  725      14,3317  00300 1                CMAJ
1400  REP   9  LAST  566      14,3320  03674 1  MKDNCDR  ECADR  MARKDOWN
1401  REP   2  LAST  169      14,3321  03502 0           ECADR  MARK2DWN
```

```
P1402   PROGRAM DESCRIPTION - R53 - SIGHTING MARK ROUTINE
R1403   MOD.NO.2  21 DEC 66
R1404   MOD BY STURLAUGSON

R1405   FUNCTIONAL DESCRIPTION
R1406           TO PERFORM A SATISFACTORY NUMBER OF SIGHTING MARKS FOR THE REQUESTING PROGRAM (OR ROUTINE). SIGHTINGS
R1408   CAN BE MADE ON A STAR OR LANDMARK. WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES 5 ANGLES (3 ICDUS AND 2
R1410   OCDUS) AND THE TIME OF THE MARK.

R1411   CALLING SEQUENCE
R1412     R53 IS CALLED AND RETURNS IN INTERPRETIVE CODE. RETURN IS VIA QPRET.
R1413     THERE IS NO ERROR EXIT IN THIS ROUTINE ITSELF.

R1414   SUBROUTINES CALLED
R1415     SXTMARK
R1416     OPTSTALL
R1417     GOFLASH

R1418   ERASABLE INITIALIZATION
R1419     TARGET FLAG - STAR OR LANDMARK
R1420     MARKINDX - NUMBER OF MARKS WANTED
R1421     STARIND - INDEX TO BESTI OR BESTJ (STAR NUMBER)
R1422   OUTPUT
R1423     MARKSTAT CONTAINS INDEX TO VACANT AREA WHERE MARK DATA IS STORED
R1424     BESTI (INDEXED BY STARIND) CONTAINS STAR NUMBER SIGHTED
R1425   DEBRIS
R1426     MARKINDX CONTAINS NUMBER OF MARKS DESIRED
 1427   REF   2  LAST  622    14,2000                    SETLOC RT53
 1428                         14,3322                    BANK

 1429   REF   1                                          COUNT  14/R53

 1430                         14,3322   43020 1  R53     STQ    SET          SET SIGHTING MARK FLAG
 1431   REF   2  LAST  115    14,3323   03501 0           R53EXIT
 1432   REF   2  LAST  699    14,3324   00071 1           R53FLAG
 1433                         14,3325   77776 1  EXIT
 1434   REF   8  LAST  723    14,3326   3 0301 0 R53A     CA     MARKINDX     NUMBER OF MARKS
 1435   REF   2  LAST  196    14,3327   7 4716 1          MASK   LOW3
 1436   REF 210  LAST  723    14,3330   0 4555 0          TC     BANKCALL
 1437   REF   2  LAST  446    14,3331    16002 1          CADR   SXTMARK
 1438   REF 211  LAST  726    14,3332   0 4555 0          TC     BANKCALL
 1439   REF   2  LAST  446    14,3333    17512 1          CADR   OPTSTALL
 1440   REF   6  LAST  722    14,3334   0 5644 1          TC     CURTAINS
 1441   REF  35  LAST  725    14,3335   51=330 0          INDEX  MARKSTAT
 1442   REF  15  LAST  710    14,3336   10 052 1          CCS    QPRET        NUMBER OF MARKS ACTUALLY DONE
 1443   REF   1               14,3337   1 3350 0          TCF    R53B
 1444                         14,3340   1 3342 0          TCF    +2           ZERO
 1445                         14,3341   1 3342 0          TCF    +1           CCS HOLE
 1446   REF 146  LAST  724    14,3342   3 4714 1          CAF    ZERO         HOUSEKEEP VAC AREA SAVE
 1447   REF  36  LAST  726    14,3343   57=330 0          XCH    MARKSTAT      AND MARKSTAT
```

```
1448  REF 176  LAST  721   14,3344  10 000 0          CCS   A
1449  REF 177  LAST  727   14,3345  50 000 1          INDEX A
1450                       14,3346  54 000 0          TS    0
1451  REF   1              14,3347  1 3326 1          TCF   R53A
1452  REF  11  LAST  723   14,3350  0 5253 0  R53B    TC    CHECKMM
1453                       14,3351   00026 0          MM    22
1454                       14,3352  1 3354 1          TCF   +2
1455  REF   1              14,3353  1 3400 1          TCF   R53D
14551 REF  12  LAST  727   14,3354  0 5253 0          TC    CHECKMM
14552                      14,3355   00027 1          MM    23
14553 REF   1              14,3356  1 3360 0          TCF   R53C
14554 REF   2  LAST  727   14,3357  1 3400 1          TCF   R53D
1456  REF   1              14,3360  3 3404 1  R53C    CAF   V01N71
1457  REF 212  LAST  726   14,3361  0 4555 0          TC    BANKCALL
1458  REF  16  LAST  711   14,3362   20763 1          CADR  GOFLASHR
1459  REF  56  LAST  722   14,3363  0 4106 1          TC    GOTOPOOH    TERM.
1460  REF   1              14,3364  1 3371 0          TCF   R53Z
1461  REF   2  LAST  727   14,3365  0 3360 1          TC    R53C        RECYCLE
1462  REF  25  LAST  711   14,3366  3 6211 0          CAF   SIX
1463  REF  14  LAST  711   14,3367  0 5415 1          TC    BLANKET
1464  REF  95  LAST  711   14,3370  0 5112 0          TC    ENDOFJOB
1465  REF   2  LAST  476   14,3371  4 7713 1  R53Z    CS    HIGH9
1466  REF   7  LAST  711   14,3372  7 0735 1          MASK  STARCODE
1467                       14,3373  0 0006 1          EXTEND
1468  REF   1              14,3374  7 6211 1          MP    SIGHTSIX
1469  REF  68  LAST  683   14,3375  56 001 0          XCH   L
1470  REF  14  LAST  725   14,3376  50 304 0          INDEX STARIND
1471  REF  12  LAST  711   14,3377  54 302 1          TS    BESTI
1472  REF 186  LAST  724   14,3400  0 6006 1  R53D    TC    INTPRET
1473                       14,3401   77614 1  R53OUT  SETGO
1474  REF   2  LAST  699   14,3402   03420 1                TERMIFLG    SET TERMINATE FOR R52
1475  REF   3  LAST  726   14,3403   03501 0                R53EXIT
1476  REF  26  LAST  727      6211             SIGHTSIX =  SIX
1477                       14,3404   00307 0  V01N71  VN    0171
```

L P51-P53

```
P1478  NAME-S52.2
R1479  FUNCTION-COMPUTE GIMBAL ANGLES FOR DESIRED SM AND PRESENT VEHICLE
R1480  CALL- CALL S52.2
R1481  INPUT- X,Y,ZSMD
R1482  OUTPUT- OGC,IGC,MGC,THETAD,+1,+2
R1483  SUBROUTINES-CDUTRIG,CALCSMSC,MATMOVE,CALCGA
 1484  BSF  1                  11,2000                        SETLOC  S52/2
 1485                          11,2256                        BANK
 1486  BSF  1                                                 COUNT   13/S52.2
 1487                          11,2256  77620 0  S52.2        STQ
 1488  BSF  6 LAST 725         11,2257  00300 1                 QMAJ
 1489                          11,2260  77624 1                CALL
 1490  BSF  7 LAST 707         11,2261  47432 1                 CDUTRIG
 1491                          11,2262  77624 1                CALL
 1492  BSF  2 LAST 707         11,2263  34567 1                 CALCSMSC
 1493                          11,2264  66370 0                AXT,1   SSP
 1494                          11,2265  00022 1                        18D
 1495  BSF  29 LAST 725        11,2266  00051 0                        S1
 1496                          11,2267  00006 1                        6D
 1497                          11,2270  61373 1  S52.2A        VLOAD*  VXM
 1498  BSF  7 LAST 716         11,2271  02736 1                        XNB +18D,1
 1499  BSF  26 LAST 724        11,2272  01736 1                        REPSMMAT
 1500                          11,2273  77656 1                UNIT
 1501  BSF  6 LAST 728         11,2274  06736 0                STORE   XNB +18D,1
 1502                          11,2275  77700 0                TIX,1
 1503  BSF  1                  11,2276  22270 1                        S52.2A
 1504                          11,2277  75160 1  S52.2.1      AXC,1   AXC,2
 1505  BSF  6 LAST 698         11,2300  00306 1                        XSMD
 1506  BSF  32 LAST 717        11,2301  02671 0                        XSM
 1507                          11,2302  77624 1                CALL
 1508  BSF  3 LAST 724         11,2303  31040 1                 MATMOVE
 1509                          11,2304  77624 1                CALL
 1510  BSF  2 LAST 417         11,2305  47244 0                 CALCGA
 1511                          11,2306  77650 1                GOTO
 1512  BSF  9 LAST 728         11,2307  00300 1                 QMAJ
```

```
P1513   PROGRAM NAME - SR52.1              DATE DEC 20  66
R1514   MOD 1                             LOG SEC  P51-P53
R1515   BY  KEN VINCENT                   ASSEMBLY  SUNDISK  REV 40
R1516
R1517   FUNCTION
R1518    TARG1 AND TARG2 FLAGS ARE LOOKED AT TO DETERMINE IF THE TARGET IS THE
R1519    LEM, STAR OR LANDMARK. IN CASE OF LEM OR LAX,THE PRESENT TIME PLUS
R1520    2 SECONDS IS SAVED IN AOPTIME (ALIAS STARAD ,+1 ). IF THE LEM  IS
R1521    THE TARGET  THEN CONIC UPDATES      OF THE CSM AND LEM ARE MADE TO
R1522    THE TIME IN AOPTIME. THE UNIT OF THE DIFFERENCE OF LEM AND CSM
R1523    POSITION VECTORS BECOMES THE REFERENCE SIGHTING VECTOR  USED IN THE
R1524    COMMON PART OF THIS PROGRAM.
R1525    IN THE CASE OF LANDMARK, THE CSM IS UPDATED CONICALLY. THE RADIUS
R1526    VECTOR FOR THE LANDMARK IS OBTAINED FROM LALOTORV. BOTH OF THESE ARE
R1527    FOUND FOR THE TIME IN AOPTIME. THE UNIT OF THE DIFFERENCE BETWEEN
R1528    THE LANDMARK AND CSM RADIUS VECTORS BECOMES THE REFERENCE SIGHTING
R1529    VECTOR FOR THE COMMON PART OF THIS ROUTINE.
R1530    IF A STAR IS THE TARGET, THE PROPER STAR IS OBTAINED FROM THE CATALOG
R1531    AND THIS VECTOR BECOMES THE REFERENCE SIGHTING VECTOR.
R1532    THE COMMON PART OF THIS PROGRAM  TRANSFORMS THE REFERENCE SIGHTING
R1533    VECTOR INTO STABLE MEMBER COORDINATES. IT READS THE IMU-CDUS AND USES
R1534    THIS DATA IN A CALL TO CALCSXA. ON RETURN FROM CALCSXA A TEST IS
R1535    MADE TO SEE IF THE TRUNNION ANGLE IS GREATER THAN  90DEG OR 38DEG.
R1536    MADE TO SEE IF THE TRUNNION ANGLE IS GREATER THAN 90DEG. OR 50DEG.

R1537   CALLING SEQUENCE
R1538   L+4       RETURN WHEN SHAFT OR TRUNION NOT WITHIN 5DEG OF DESIRED
R1539   L         TC      BANKCALL
R1540   L+1       CADR    SR52.1
R1541   L+2       ERROR RETURN    TRUNNION GREATER THAN 90DEG
R1542   Ld3       ERROR RETURN    TRUNNION GREATER THAN 50DEG
R1543   L+4       NORMAL RETURN
R1544
R1545   OUTPUT
R1546   SAC -SINGLE PREC,2S COMP,SCALED AT HALF REVS- SHAFT ANGLE DESIRED
R1547   PAC -SINGLE PREC,2S COMP SCALED AT EIGTH REVS - TRUNNION ANGLE DESIRED
R1548
R1549   INITIALIZATION
R1550   IF TARG1FLG =1 THEN TARGET IS LEM -NO OTHER INPUT REQUIRED
R1551   IF TARG1FLG =0 AND TARG2FLG =0 THE TARGET IS STAR, STARIND SHOULD
R1552   0 OR 1 DENOTING BESTI OR BESTJ RESPECTIVELY AS STAR CODE. STAR CODES
R1553   ARE 6 TIMES STAR NUMBER.
R1554   IF TARG1FLG=0 AND TARG2FLG=1 THEN TARGET IS LANDMARK. SEE ROUTINE
R1555   LALOTORV FOR INPUT REQUIREMENTS. HERE FIXERAD=1 FOR CONSTANT EARTH
R1556   RADIUS
R1557
R1558   DEBRIS
R1559    WORK AREA
R1560    STARAD - STAR+5 (STAR IS DESIRED LOS IN STABLE MEMBER COORDINATES)
 1561   REF   1                                          COUNT* $$/SR521
```

```
1562  REP   1                 13,2000                        SETLOC  SR52/1
1563                          13,2176                        BANK

1564  REP   4  LAST  707     13,2176  0 4604 1  SR52.1      TC      MAKECADR
1565  REP  11  LAST  716     13,2177  55#777 0               TS      OMIN
1566  REP 187  LAST  727     13,2200  0 6006 1               TC      INTPRET
1567                          13,2201   43234 0              RTB     DAD
1568  REP  21  LAST  711     13,2202   45505 0                      LOADTIME
1569  REP   1                 13,2203   26317 0                      1.3SECDP
1570  REP   3  LAST   89      13,2204   02356 0              STORE   AOPTIME
1571                          13,2205   43014 0              BON     BON
1572  REP   6  LAST  711     13,2206   00705 0                      TARG1FLG
1573  REP   1                 13,2207   26214 1                      LEM52
1574  REP   5  LAST  723     13,2210   00706 0                      TARG2FLG
1575  REP   1                 13,2211   26224 1                      LMK52
1576                          13,2212   77650 1              GOTO
1577  REP   1                 13,2213   26245 0                      STAR52
1578                          13,2214   77745 1  LEM52       DLOAD
1579  REP   4  LAST  730     13,2215   02356 0                      AOPTIME
1580  REP  40  LAST  704     13,2216   34041 0              STCALL  TDEC1
1581  REP   4  LAST  586     13,2217   27057 0                      LEMCONIC
1582                          13,2220   77775 1              VLOAD
1583  REP  27  LAST  705     13,2221   00001 0                      RATT
1584                          13,2222   77650 1              GOTO
1585  REP   1                 13,2223   26234 0                      LMKLMCOM
1586                          13,2224   71214 0  LMK52       BON     DLOAD
1587  REP   3  LAST  702     13,2225   04305 0                      ADVTRK
1588  REP   1                 13,2226   54000 0                      ADVTRACK
1589  REP   5  LAST  730     13,2227   02356 0                      AOPTIME
1590                          13,2230   77624 1              CALL
1591  REP   6  LAST  698     13,2231   26373 1                      LALOTORV
1592                          13,2232   77775 1              VLOAD
1593  REP  10  LAST  698     13,2233   02152 0                      ALPHAV
1594  REP  11  LAST  445     13,2234   16766 1  LMKLMCOM    STODL   STAR
1595  REP   6  LAST  730     13,2235   02356 0                      AOPTIME
1596  REP  41  LAST  730     13,2236   34041 0              STCALL  TDEC1
1597  REP   6  LAST  704     13,2237   27045 0                      CSMCONIC
1598                          13,2240   52375 1              VLOAD   VSU
1599  REP  12  LAST  730     13,2241   02766 1                      STAR
1600  REP  28  LAST  730     13,2242   00001 0                      RATT
1601                          13,2243   52056 0              UNIT    GOTO
1602  REP   1                 13,2244   26260 1                      COM52
1603                          13,2245   72131 1  STAR52      SSP     LXA,1
1604  REP  30  LAST  726     13,2246   00051 0                      S1
1605                          13,2247   00000 1                      0
1606  REP  15  LAST  727     13,2250   00304 0                      STARIND
1607                          13,2251   77700 0              TIX,1
1608  REP   1                 13,2252   26256 1                      ST52ST
1609                          13,2253   52175 0              VLOAD   GOTO
1610  REP   9  LAST  724     13,2254   02617 0                      STARSAV2
```

```
1611  REF   2  LAST  730   13,2255   26260 1                    COM52
1612                       13,2256   77775 1  ST52ST  VLOAD
1613  REF   7  LAST  724   13,2257   02811 0                    STARSAV1
1614                       13,2260   53521 1  COM52   MXV       UNIT
1615  REF  27  LAST  728   13,2261   01736 1                    REFSMMAT
1616  REF  13  LAST  730   13,2262   02766 1           STORE    STAR
1617                       13,2263   45001 1           SETPD    CALL
1618                       13,2264   00001 0                    0
1619  REF   8  LAST  728   13,2265   47432 1                    CDUTRIG     COMPUTES SINES AND COSINES FOR CALCSXA
1620                       13,2266   77624 1           CALL                 NOW EXPECT TO SEE THE CDU ANGLES.
1621  REF   1              13,2267   46034 1                    CALCSXA
1622                       13,2270   77414 0           BOFF     EXIT
1623  REF   8  LAST  710   13,2271   01750 1                    CULTFLAG
1624  REF   1              13,2272   26274 1                    TRUN38
1625  REF   1              13,2273   0 2312 0          TC       SR52E1
1626                       13,2274   45345 1  TRUN38  DLOAD    DSU
1627  REF   8  LAST  700   13,2275   02776 0                    PAC
1628  REF   1              13,2276   26315 1                    38TRDEG
1629                       13,2277   71244 0           BPL      DLOAD
1630  REF   1              13,2300   26305 0                    SR52E22
1631  REF   9  LAST  731   13,2301   02776 0                    PAC
1632                       13,2302   51025 1           DSU      BPL
1633  REF   1              13,2303   26321 0                    20DEGSMN
1634  REF   1              13,2304   26307 1                    SR52E3
1635                       13,2305   77776 1  SR52E22 EXIT
1636  REF   1              13,2306   0 2311 0          TC       SR52E2
1637                       13,2307   77776 1  SR52E3  EXIT
1638  REF  12  LAST  730   13,2310   25000 1           INCR     OMIN
1639  REF  13  LAST  731   13,2311   25000 1  SR52E2   INCR     OMIN
1640  REF  14  LAST  731   13,2312   3 1777 1 SR52E1   CA       OMIN
1641  REF   4  LAST  710   13,2313   0 4561 1          TC       SWCALL
1642                       13,2314   25252 0  38TRDEG 2DEC     .66666667   CORESPONDS TO 50 DEGS IN TRUNION
1642                       13,2315   25254 0
1643                       13,2316   00000 1  1.3SECDP 2DEC    130
1643                       13,2317   00202 1
1644                       13,2320   61740 0  20DEGSMN DEC     -07199
1645                       13,2321   77777 0           DEC      -0
```

```
P1646     THE ADVTRACK ROUTINE IS USED TO COMPUTE AN OPTICS LOS VECTOR TO
R1647     A POINT ON THE GROUND TRACK 60 DEGRESS FORWARD OF THE LOCAL VERTICAL
R1648     OF AN ADVANCED ORBIT A SPECIFIED NUMBER OF REVOLUTIONS FROM NOW

1649  REF   1                 26,2000                    SETLOC  26P50S
1650                          26,2000                    BANK
1651                          26,2000  77601 0  ADVTRACK SETPD
1652                          26,2001  00001 0           0
1653                          26,2002  41575 0           VLOAD   PUSH        INITIALIZE FOR RP-TO-R
1654  REF   2  LAST  32       26,2003  15324 0                   UNITZ       UZ VEC IN PD 0-5
1655                          26,2004  41434 1           RTB     PUSH        TIME IN PD 6-7
1656  REF  22  LAST 730       26,2005  45505 0                   LOADTIME
1657  REF   7  LAST 730.      26,2006  36356 1           STCALL  AOPTIME     TIME ALSO IN AOPTIME FOR CSMCONIC
1658  REF   4  LAST 697       26,2007  55341 1                   RP-TO-R     GET MOON ROTATION VEC IN REF
1659  REF  14. LAST 731       26,2010  16766 1           STODL   STAR
1660  REF   6  LAST 732       26,2011  02356 0                   AOPTIME     PICK UP TIME
1661  REF  42  LAST 730       26,2012  34041 0           STCALL  TDEC1       UPDATE STATE TO TIME
1662  REF   7  LAST 730       26,2013  27045 0                   CSMCONIC
1663                          26,2014  47375 0           VLOAD   VXV
1664  REF  20  LAST 705       26,2015  00007 0                   VATT
1665  REF  29  LAST 730       26,2016  00001 0                   RATT
1666                          26,2017  77656 1           UNIT
1667                          26,2020  24031 0           STOVL   24D         SAVE -UNIT(V X R) FOR 2ND ROTATION
1668  REF  30  LAST 732       26,2021  00001 0                   RATT
1669                          26,2022  57456 1           UNIT    VCOMP
1670                          26,2023  41401 1           SETPD   PUSH        PUSH LOS=-UNIT(RVEC)  PD 0-5
1671                          26,2024  00001 0                   0
1672                          26,2025  77776 1           EXIT
1673  REF  23  LAST 614       26,2026  3 1751 0          CA      LANDMARK
1674  REF  12  LAST 595       26,2027  7 4716 1          MASK    SEVEN       GET NUMBER OF ADVANCE PERIODS
1675                          26,2030  0 0006 1          EXTEND
1676  REF  22  LAST 667       26,2031  7 4700 0          MP      BIT11       GET N/16
1677  REF  69  LAST 727       26,2032  56 001 0          XCH     L
1678  REF  15  LAST 717       26,2033  50 120 1          INDEX   FIXLOC
1679                          26,2034  54 036 0          TS      30D         TEMP STORE N/16
1680  REF 166  LAST 730       26,2035  0 6006 1          TC      INTPRET
1681                          26,2036   41335 1          SLOAD   DMP
1682                          26,2037   00037 0                   30D
1683  REF   1                 26,2040   14107 1                   MPERIOD
1684  REF   9  LAST 732       26,2041   36356 1          STCALL  AOPTIME     ROTATE ANG ABOUT UR
1685  REF   1                 26,2042   54057 1                   ROTA
1686                          26,2043   77775 1          VLOAD
1687                          26,2044   00031 0                   24D         PICK UP 2ND ROTATION AXIS
1688  REF  15  LAST 732       26,2045   16766 1          STODL   STAR
1689  REF   1                 26,2046   14105 0                   DP1/6
1690                          26,2047   77625 0          DSU
1691  REF  10  LAST 732       26,2050   02356 0                   AOPTIME     2ND RAT ANGLE = 60 - A
1692  REF  11  LAST 732       26,2051   36356 1          STCALL  AOPTIME
1693  REF   2  LAST 732       26,2052   54057 1                   ROTA        GO ROTATE 2ND TIME
1694                          26,2053   77775 1          VLOAD
```

```
1695                        26,2054  00001 0                    0
1696  REP  16 LAST T32      26,2055  38766 0          STCALL    STAR        STORE FINAL LOS IN STAR
1697  REP   3 LAST T31      26,2056  26260 1                    COM52       RETURN TO SR52.1

1698                        26,2057  73545 1  ROTA      DLOAD     SIN
1699  REP  12 LAST T32      26,2060  02356 0                    AOPTIME
1700                        26,2061  47315 0          PDVL      VXV         PUSH 1/2SIN(A)  PD  6-7
1701  REP  17 LAST T33      26,2062  02766 1                    STAR          UR VEC
1702                        26,2063  00001 0                    0             LOS
1703                        26,2064  72561 0          VXSC      VSL2        1/2SIN(A)(URXLOS)  PD 6-11.
1704                        26,2065  50315 0          PDVL      DOT
1705  REP  16 LAST T33      26,2066  02766 1                    STAR
1706                        26,2067  00001 0                    0
1707                        26,2070  72561 0          VXSC      VSL2
1708  REP  19 LAST T33      26,2071  02766 1                    STAR
1709                        26,2072  71525 0          PDDL      COS         1/2(UR . LOS)UR  12-17
1710  REP  13 LAST T33      26,2073  02356 0                    AOPTIME
1711                        26,2074  51315 1          PDVL      BVSU        PUSH 1/2COS(A)  16-19
1712                        26,2075  00015 0                    12D
1713                        26,2076  00001 0                    0
1714                        26,2077  76561 1          VXSC      VSL1        UP 18-19
1715                        26,2100  53255 0          VAD       VAD         UP 12-17  UP 6-11
1716                        26,2101  40256 1          UNIT      SETPD
1717                        26,2102  00001 0                    0
1718                        26,2103  43406 1          PUSH      RVQ

1719                        26,2104  05252 1  DP1/8     2DEC      .16666666
1719                        26,2105  25251 0
1720                        26,2106  01414 1  MPERIOD   2DEC      .047619  .     APPROX LUNAR ROT ANG IN 2HRS X 16
1720                        26,2107  06044 1
```

```
P1721   NAME-S52.3
R1722   FUNCTION- XSMD= UNIT(YSMD X ZSMD)
R1723             YSMD= UNIT(V X R)
R1724             ZSMD= UNIT(-R)
R1725   CALL      DLOAD  CALL
R1726                    TALIGN
R1727                    S52.3
R1728   INPUT-    TIME OF ALIGNMENT IN MPAC
R1729   OUTPUT-   X,Y,ZSMD
R1730   SUBROUTINES- CSMCONIC
 1731   REF    3  LAST  718   16,2000                          SETLOC P50S2
 1732                        16,2636                          BANK

 1733   REF    1                                             COUNT  15/S52.3
 1734                        16,2636   77620 0   S52.3       STQ
 1735   REF   10  LAST  726   16,2637   00300 1                    QMAJ
 1736   REF   43  LAST  732   16,2640   34041 0              STCALL TDEC1
 1737   REF    8  LAST  732   16,2641   27045 0                     CSMCONIC
 1736                        16,2642   77601 0              SETPD
 1739                        16,2643   00001 0                     0
 1740                        16,2644   57575 1              VLOAD  VCOMP
 1741   REF   31  LAST  732   16,2645   00001 0                     RATT
 1742                        16,2646   77656 1              UNIT
 1743   REF    3  LAST  696   16,2647   24323 0              STOVL  ZSMD
 1744   REF   21  LAST  732   16,2650   00007 0                     VATT
 1745                        16,2651   53435 0              VXV    UNIT
 1746   REF   32  LAST  734   16,2652   00001 0                     RATT
 1747   REF    4  LAST  696   16,2653   00315 0              STORE  YSMD
 1746                        16,2654   53435 0              VXV    UNIT
 1749   REF    4  LAST  734   16,2655   00323 0                     ZSMD
 1750   REF    7  LAST  726   16,2656   34307 1              STCALL XSMD
 1751   REF   11  LAST  734   16,2657   00300 1                     QMAJ
```

```
P1752   PROGRAM DESCRIPTION - R56 - ALTERNATE LOS SIGHTING MARK ROUTINE

R1753   FUNCTIONAL DESCRIPTION
R1754         TO PERFORM SIGHTING MARKS FOR THE BACK-UP ALIGNMENT PROGRAMS (P53,P54).  THE ASTRONAUT KNOWS THE
R1756   COORDINATES (OPTICS) OF THE ALTERNATE LINE OF SIGHT HE MUST USE FOR THIS ROUTINE.  WHEN THE ASTRONAUT KEYS IN
R1758   ENTER IN RESPONSE TO THE FLASHING V50 N25 R1-XXXXX THE CMC STORES THE THREE ICDU ANGLES AND TWO ANGLES DISPLAYED
R1760   IN N92.

R1761   CALLING SEQUENCE
R1762         CALL
R1763               R56

R1764   SUBROUTINES CALLED
R1765         A PORTION OF SXTMARK (VAC AREA SEARCH)
R1766         GOFLASH
R1767         GOPERF1

R1768   ERASABLE INITIALIZATION
R1769         STARIND-INDEX TO STAR NUMBER

R1770   OUTPUT
R1771         MARKSTAT-INDEX TO VAC AREA WHERE OUTPUT IS STORED.
R1772         BESTI (INDEXED BY STARIND) CONTAINS STAR NUMBER.
R1773         ICDU AND OCDU ANGLES IN VAC. AREA AS FOLLOWS-
R1774            VAC +2  CDUY
R1775            VAC +3  CDUS
R1776            VAC +4  CDUZ
R1777            VAC +5  CDUT
R1778            VAC +6  CDUX

 1779   REF   1                                                    COUNT* $$/R56
 1780   REF   5  LAST  717   15,2000                               SETLOC P50S
 1781                        15,2252                               BANK
 1782                        15,2252   77776 1  R56               EXIT
 1783   REF   1              15,2253   3 2362 1                   CAF     V06N94B
 1784   REF 213  LAST  727   15,2254   0 4555 0                   TC      BANKCALL
 1785   REF  34  LAST  718   15,2255    20624 0                   CADR    GOFLASH
 1786   REF  57  LAST  727   15,2256   0 4108 1                   TC      GOTOPOOH        TERM.
 1787   REF   1              15,2257   0 2281 0                   TC      R56A            PROCEED - ANGLES OK
 1788                        15,2260   0 2253 1                   TC      -5              ENTER - NEW ANGLES
 1789   REF 214  LAST  735   15,2281   0 4555 0  R56A             TC      BANKCALL
 1790   REF   3  LAST  728   15,2282    16004 1                   CADR    SXTMARK +2      INHIBIR EXT VB ACT AND FIND VAC AREA

17904   REF 147  LAST  726   15,2263   3 4714 1                   CAF     ZERO
17905   REF 215  LAST  735   15,2264   0 4555 0                   TC      BANKCALL
17908   REF   6  LAST  715   15,2265    20807 1                   CADR    CLEANDSP

 1791   REF   1              15,2266   3 2360 0                   CAF     VB53            DISPLAY V53 REQUESTING ALTERNATE MARK
 1792   REF 216  LAST  735   15,2267   0 4555 0                   TC      BANKCALL
 1793   REF   3  LAST  583   15,2270    20470 0                   CADR    GOMARK2
```

```
1794  BBF  58  LAST  735   15,2271  1 4106 0        TCF   GOTOPOOH      V34-TERMINATE
1795  BBF   2  LAST  735   15,2272  1 2263 0        TCF   R56A +2       V33-DONT PROCEED-JUST ENTER TO MARK
17951 BBF 189  LAST  732   15,2273  0 6006 1        TC    INTPRET
17952                      15,2274   77745 1        DLOAD
17953 BBF  36  LAST  575   15,2275   03731 1              MRKBUF1 +3
17954 BBF  10  LAST  701   15,2276   16774 1        STODL SAC
17956 BBF  37  LAST  736   15,2277   03733 0              MRKBUF1 +5
17957 BBF  10  LAST  731   15,2300   02776 0        STORE PAC
17958                      15,2301   77776 1        EXIT
1796                       15,2302  0 0004 0        INHINT
1797                       15,2303  0 0006 1        EXTEND
1798  BBF  25  LAST  695   15,2304  3 0025 0        DCA   TIME2
1799  BBF  37  LAST  726   15,2305  51=330 0        INDEX MARKSTAT
1800                       15,2306  52 001 1        DXCH  0
1801  BBF   8  LAST  717   15,2307  3 0033 1        CA    CDUY          ENTER-THIS IS A BACKUP SYSTEM MARK
1802  BBF  38  LAST  736   15,2310  51=330 0        INDEX MARKSTAT
1803                       15,2311  54 002 1        TS    2
1804  BBF  11  LAST  736   15,2312  3 1773 0        CA    SAC
1805  BBF  39  LAST  736   15,2313  51=330 0        INDEX MARKSTAT
1806                       15,2314  54 003 0        TS    3
1807  BBF  11  LAST  717   15,2315  3 0034 0        CA    CDUZ
1808  BBF  40  LAST  736   15,2316  51=330 0        INDEX MARKSTAT
1809                       15,2317  54 004 1        TS    4
1810  BBF  11  LAST  736   15,2320  3 1775 0        CA    PAC
1811  BBF  41  LAST  736   15,2321  51=330 0        INDEX MARKSTAT
1812                       15,2322  54 005 0        TS    5
1813  BBF  17  LAST  717   15,2323  3 0032 0        CA    CDUX
1814  BBF  42  LAST  736   15,2324  51=330 0        INDEX MARKSTAT
1815                       15,2325  54 006 0        TS    6
1816                       15,2326  0 0003 1        RELINT
18161 BBF   4  LAST  701   15,2327  0 5425 1        TC    CLEARMRK      ENABLE EXTENDED VERBS
1817  BBF   1              15,2330  3 4333 0        CAF   OCT16
1818  BBF 217  LAST  735   15,2331  0 4555 0        TC    BANKCALL
1819  BBF   6  LAST  722   15,2332   20751 0        CADR  GOPERF1
1820  BBF  59  LAST  736   15,2333  0 4106 1        TC    GOTOPOOH      TERM.
1821  BBF   1              15,2334  1 2336 1        TCF   R56B          PROCEED-MARK COMPLETED
1822  BBF   3  LAST  736   15,2335  1 2263 0        TCF   R56A +2       RECYCLE - DO ANOTHER MARK - LIKE REJECT
18225 BBF 146  LAST  735   15,2336  3 4714 1 R56B   CAF   ZERO
1823  BBF 218  LAST  736   15,2337  0 4555 0        TC    BANKCALL
1824  BBF   7  LAST  735   15,2340   20607 1        CADR  CLEANDSP

1825  BBF   1              15,2341  3 2361 1        CAF   V01N71B
1826  BBF 219  LAST  736   15,2342  0 4555 0        TC    BANKCALL
1827  BBF  35  LAST  735   15,2343   20624 0        CADR  GOFLASH
1828  BBF  60  LAST  736   15,2344  0 4106 1        TC    GOTOPOOH
1829                       15,2345  0 2347 0        TC    +2
1830  BBF   2  LAST  736   15,2346  1 2336 1        TCF   R56B          RECYCLE
1831  BBF   3  LAST  727   15,2347  4 7713 1        CS    HIGH9
1832  BBF   8  LAST  727   15,2350  7 0735 1        MASK  STARCODE
1833                       15,2351  0 0006 1        EXTEND
```

```
1834  REF  27  LAST  727   15,2352   7 6211 1          MP      SIX
1835  REF  70  LAST  732   15,2353   56 001 0          XCH     L
1836  REF  16  LAST  730   15,2354   50 304 0          INDEX   STARIND
1837  REF  13  LAST  727   15,2355   54 302 1          TS      BESTI
1838  REF 190  LAST  738   15,2356   0 6008 1          TC      INTPRET
1839                       15,2357    77616 0          RVQ
1840                       15,2360    15200 1  VB53    VN      05300        ALTERNATE MARK VERB
1841                       15,2361    00307 0  V01N71B VN      00171
1842                       15,2362    01536 0  V06N94B VN      00894
1843  REF  13  LAST  725   15,2363    02607 1  PLANET  STORE   TSIGHT
1844                       15,2364    45020 1          STQ     CALL
1845  REF  15  LAST  731   15,2365    02777 1                  QMIN
1846  REF   2  LAST  696   15,2366    30216 1                  LOCSAM
1847                       15,2367    77775 1          VLOAD
1848  REF   5  LAST  704   15,2370    02736 1                  VEARTH
1849                       15,2371    24001 0          STOVL   0D
1850  REF   8  LAST  705   15,2372    02744 1                  VSUN
1851  REF   6  LAST  737   15,2373    26738 1          STOVL   VEARTH
1852                       15,2374    00001 0                  0D
1853  REF   9  LAST  737   15,2375    02744 1          STORE   VSUN
1854                       15,2378    77776 1  NOSAM   EXIT
1855  REF   4  LAST  736   15,2377   4 7713 1          CS      HIGH9
1858  REF   9  LAST  736   15,2400   7 0735 1          MASK    STARCODE
1857                       15,2401   0 0008 1          EXTEND
1858  REF   2  LAST  727   15,2402   7 8211 1          MP      SIGHTSIX
1859  REF  71  LAST  737   15,2403   58 001 0          XCH     L
1860  REF  17  LAST  737   15,2404   50 304 0          INDEX   STARIND
1861  REF  14  LAST  737   15,2405   54 302 1          TS      BESTI
1862  REF 178  LAST  727   15,2408   10 000 0          CCS     A
1863  REF   1               15,2407   1 2423 1          TCF     NOTPLAN
1864  REF   1               15,2410   3 2453 1          CAF     VNPLANV
1865  REF 220  LAST  738   15,2411   0 4555 0          TC      BANKCALL
1868  REF  36  LAST  738   15,2412    20824 0          CADR    GOFLASH
1867  REF  81  LAST  736   15,2413   0 4108 1          TC      GOTOPOOH
1866                       15,2414   0 2416 0          TC      +2
1869                       15,2415   0 2410 0          TC      -5
1870  REF 191  LAST  737   15,2416   0 6006 1          TC      INTPRET
1871                       15,2417    53575 0          VLOAD   UNIT
1872  REF  20  LAST  733   15,2420    02788 1                  STAR
1873                       15,2421    77650 1          GOTO
1874  REF   1               15,2422    32446 0                  CORPLAN
1875  REF 179  LAST  737   15,2423   4 0000 0  NOTPLAN CS      A
1876  REF   1               15,2424   6 2452 0          AD      DEC227
1877                       15,2425   0 0008 1          EXTEND
1878  REF   1               15,2426   8 2437 0          BZMF    CALSAM1
1879  REF  16  LAST  737   15,2427   50 304 0          INDEX   STARIND
1880  REF  15  LAST  737   15,2430   3 0302 0          CA      BESTI
1881  REF  16  LAST  732   15,2431   50 120 1          INDEX   PIXLOC
1882  REF  32  LAST  708   15,2432   54 048 1          TS      X1
1883  REF 192  LAST  737   15,2433   0 6006 1          TC      INTPRET
```

```
1884
1885  REF  10  LAST  709    15,2434   52173 0                VLOAD*  GOTO
1886  REF   2  LAST  737    15,2435   31744 1                        CATLOG,1
1887  REF 193  LAST  737    15,2438   32448 0                        CORPLAN
1888                        15,2437   0 8008 1  CALSAM1      TC      INTPRET
1889  REF  19  LAST  737    15,2440   70740 0                LXC,1   DLOAD*
1890  REF  16  LAST  737    15,2441   00304 0                        STARIND
1891                        15,2442   00303 1                        BESTI,1
1892  REF 275  LAST  725    15,2443   76740 0                LXC,1   VLOAD*
1893  REF  10  LAST  724    15,2444   00154 1                        MPAC
1894                        15,2445   02372 0                        STARAD -228D,1
1895  REF   5  LAST  705    15,2446   53455 0  CORPLAN       VAD     UNIT
1896                        15,2447   03474 0                        VEL/C
1897  REF  18  LAST  737    15,2450   77850 1                GOTO
1898                        15,2451   02777 1                        QMIN
1899                        15,2452   00343 0  DEC227        DEC     227
                            15,2453   01530 0  VNPLANV       VN      0888
```

L LUNAR AND SOLAR EPHEMERIDES SUBROUTINES USER'S PAGE NO. 1 E0 S3

P0001 LUNAR AND SOLAR EPHEMERIDES SUBROUTINES

R0002 FUNCTIONAL DESCRIPTION

R0003 THESE SUBROUTINES ARE USED TO DETERMINE THE POSITION AND VELOCITY
R0004 VECTORS OF THE SUN AND THE MOON RELATIVE TO THE EARTH AT THE
R0005 SPECIFIED GROUND ELAPSED TIME INPUT BY THE USER.

R0006 THE POSITION OF THE MOON IS STORED IN THE COMPUTER IN THE FORM OF
R0007 A NINTH DEGREE POLYNOMIAL APPROXIMATION WHICH IS VALID OVER A 15
R0008 DAY INTERVAL BEGINNING SHORTLY BEFORE LAUNCH. THEREFORE THE TIME
R0009 INPUT BY THE USER SHOULD FALL WITHIN THIS 15 DAY INTERVAL.

R0010 LSPOS COMPUTES THE POSITION VECTORS OF THE SUN AND THE MOON.

R0011 LUNPOS COMPUTES THE POSITION VECTOR OF THE MOON.

R0012 LUNVEL COMPUTES THE VELOCITY VECTOR OF THE MOON.

R0013 SOLPOS COMPUTES THE POSITION VECTOR OF THE SUN.

R0014 CALLING SEQUENCE

R0015 DLOAD CALL
R0016 TIME GROUND ELAPSED TIME
R0017 SUBROUTINE LSPOS OR LUNPOS OR LUNVEL OR SOLPOS

R0018 INPUT

R0019 1) SPECIFIED GROUND ELAPSED TIME IN CS X B-28 LOADED IN MPAC.

R0020 2) TIMEMO - TIME AT THE CENTER OF THE RANGE OVER WHICH THE LUNAR
R0021 POSITION POLYNOMIAL IS VALID IN CS X B-42.

R0022 3) VECOEM - VECTOR COEFFICIENTS OF THE LUNAR POSITION POLYNOMIAL
R0023 LOADED IN DESCENDING SEQUENCE IN METERS/CS**N X B-2

R0024 4) RESO - POSITION VECTOR OF THE SUN RELATIVE TO THE EARTH AT
R0025 TIMEMO IN METERS X B-38.

R0026 5) VESO - VELOCITY VECTOR OF THE SUN RELATIVE TO THE EARTH AT
R0027 TIMEMO IN METERS/CS X B-9.

R0028 6) OMEGAES - ANGULAR VELOCITY OF THE VECTOR RESO AT TIMEMO IN
R0029 REV/CS X B+26.

R0030 ALL EXCEPT THE FIRST INPUT ARE INCLUDED IN THE PRE-LAUNCH
R0031 ERASABLE DATA LOAD.

R0032 OUTPUT - LSPOS

R0033 1) 2D OF VAC AREA CONTAINS THE POSITION VECTOR OF THE SUN RELATIVE
R0034 TO THE EARTH AT TIME INPUT BY THE USER IN METERS X B-38.

R0035 2) MPAC CONTAINS THE POSITION VECTOR OF THE MOON RELATIVE TO THE
R0036 EARTH AT TIME INPUT BY THE USER IN METERS X B-29.

R0037 OUTPUT - LUNPOS

R0038 MPAC CONTAINS THE POSITION VECTOR OF THE MOON RELATIVE TO THE
R0039 EARTH AT THE TIME INPUT BY USER IN METERS X B-29.

R0040 OUTPUT - LUNVEL

R0041 MPAC CONTAINS THE VELOCITY VECTOR OF THE MOON RELATIVE TO THE
R0042 EARTH AT TIME INPUT BY THE USER IN METERS/CS X B-7.

R0043 OUTPUT - SOLPOS

R0044 MPAC CONTAINS THE POSITION VECTOR OF THE SUN RELATIVE TO THE EARTH
R0045 AT TIME INPUT BY THE USER IN METERS X B-38.

R0046 SUBROUTINES USED

R0047 NONE

R0048 REMARKS

R0049 THE VAC AREA IS USED FOR STORAGE OF INTERMEDIATE AND FINAL RESULTS
R0050 OF COMPUTATIONS.

R0051 S1, X1 AND X2 ARE USED BY THESE SUBROUTINES.
R0052 PRELAUNCH ERASABLE DATA LOAD ARE ONLY ERASABLE STORAGE USED BY
R0053 THESE SUBROUTINES.
R0054 RESTARTS DURING OPERATION OF THESE SUBROUTINES MUST BE HANDLED BY
R0055 THE USER.

```
0056                          36,2502                  BANK   36
0057  REF  1                  26,2000                  SETLOC EPHEM
0058                          26,2110                  BANK

0059  REF  1                                           COUNT* $$/EPHEM
0060  REF  2  LAST  210       E7,1777                  EBANK= END-E7
0061                          26,2110   77774 0  LSPOS  AXT,2
0062  REF  1                  26,2111   54161 0                 RESA
0063                          26,2112   52170 0         AXT,1   GOTO
0064  REF  1                  26,2113   54143 0                 RES
0065  REF  1                  26,2114   54126 0                 LSTIME
0066                          26,2115   52170 0  LUNPOS  AXT,1   GOTO
0067  REF  1                  26,2116   54162 0                 REM
0068  REF  2  LAST  740       26,2117   54126 0                 LSTIME
```

COMPUTES POSITION VECTORS OF BOTH THE SUN AND THE MOON. THE POSITION VECTOR OF THE SUN IS STORED IN 2D OF THE VAC AREA. THE POSITION VECTOR OF THE MOON IS STORED IN MPAC.
COMPUTES THE POSITION VECTOR OF THE MOON AND STORES IT IN MPAC.

```
0069                          26,2120  52170 0  LUNVEL   AXT,1   GOTO          COMPUTES THE VELOCITY VECTOR OF THE MOON
0070  REF  1                  26,2121  54173 0           VEM     VEM           AND STORES IT IN MPAC.
0071  REF  3  LAST  740       26,2122  54126 0                   LSTIME
0072                          26,2123  76020 1  SOLPOS   STQ     AXT,1         COMPUTES THE POSITION VECTOR OF THE SUN
0073  REF  12 LAST  676       26,2124  00047 1                   X2            AND STORES IT IN MPAC.
0074  REF  2  LAST  740       26,2125  54143 0                   RES
0075                          26,2126  54201 0  LSTIME   SETPD   SR
0076                          26,2127  00001 0                   0D
0077                          26,2130  20617 0                   14D
0078                          26,2131  57571 0           TAD     DCOMP
0079  REF  12 LAST  530       26,2132  01707 0                   TEPHEM
0080                          26,2133  57571 0           TAD     DCOMP
0081  REF  2  LAST  86        26,2134  02034 1                   TIMEMO
0082                          26,2135  66261 1           SL      SSP
0083                          26,2136  20221 1                   16D
0084  REF  31 LAST  730       26,2137  00051 0                   S1
0085                          26,2140  00006 1                   6D
0086                          26,2141  77650 1           GOTO
0087  REF  33 LAST  737       26,2142  00046 0                   X1
0088                          26,2143  41206 0  RES      PUSH    DMP                                          PD- 2
0089  REF  1                  26,2144  02147 1                   OMEGAES
0090                          26,2145  71406 0           PUSH    COS                                          PD- 4
0091                          26,2146  65361 0           VXSC    PDDL                                         PD- 8
0092  REF  2  LAST  67        26,2147  02133 1                   RESO
0093                          26,2150  63356 1           SIN     PDVL                                         PD-10
0094  REF  3  LAST  741       26,2151  02133 1                   RESO
0095                          26,2152  53406 0           PUSH    UNIT                                         PD-16
0096                          26,2153  53435 0           VXV     UNIT
0097  REF  3  LAST  616       26,2154  02141 1                   VESO
0098                          26,2155  76435 1           VXV     VSL1                                         PD-10
0099                          26,2156  53361 0           VXSC    VAD                                          PD-02
0100                          26,2157  52172 1           VSL1    GOTO          RES IN METERS X B-38 IN MPAC.
0101  REF  13 LAST  741       26,2160  00047 1                   X2
0102                          26,2161  14003 1  RESA     STODL   2D            RES IN METERS X B-38 IN 2D OF VAC.  PD- 0
0103                          26,2162  63370 0  REM      AXT,1   PDVL                                         PD- 2
0104                          26,2163  00066 1                   54D
0105  REF  2  LAST  86        26,2164  02037 1                   VECOEM
0106                          26,2165  52761 0  REMA     VXSC    VAD*
0107                          26,2166  00001 0                   0D
0108  REF  3  LAST  741       26,2167  02133 1                   VECOEM +60D,1
0109                          26,2170  72500 1           TIX,1   VSL2          REM IN METERS X B-29 IN MPAC.
0110  REF  1                  26,2171  54165 1                   REMA
0111                          26,2172  77616 0           RVQ
0112                          26,2173  65370 0  VEM      AXT,1   PDDL                                         PD- 2
0113                          26,2174  00060 1                   48D
0114  REF  1                  26,2175  14214 0                   NINEB4
0115                          26,2176  74206 0           PUSH    VXSC                                         PD- 4
0116  REF  4  LAST  741       26,2177  02037 1                   VECOEM
0117                          26,2200  77761 1  VEMA     VXSC
0118                          26,2201  00001 0                   0D
```

```
0119                        26,2202  14005 1          STODL  4D                                    PD- 2
0120                        26,2203  41425 1          DSU    PUSH                                  PD- 4
0121  REF  1                26,2204  14216 1                 ONEB4
0122                        26,2205  53357 0          VXSC*  VAD
0123  REF  5  LAST  741     26,2206  02125 0                 VECOEM +54D,1
0124                        26,2207  00005 1                 4D
0125                        26,2210  72500 1          TIX,1  VSL2          VEM IN METERS/CS X B-7 IN MPAC.
0126  REF  1                26,2211  54200 1                 VEMA
0127                        26,2212  77616 0          RVQ
0128                        26,2213  22000 1  NINEB4   2DEC   9.0 B-4
0128                        26,2214  00000 1
0129                        26,2215  02000 0  ONEB4    2DEC   1.0 B-4
0129                        26,2216  00000 1
```

L P61-P67 USER=S PAGE NO. 1 E0 S3

```
R0001   PROGRAM'            P61
R0002   MOD NO.'            0    MAR. 13, 1967
R0003   MOD BY'             R. HIRSCHKOP
R0004   MOD NO' 1           MOD BY' RR BAIRNSFATHER      DATE' 22 JUN 87    RESTARTS.
R0008   MOD NO' 2           MOD BY' RR BAIRNSFATHER      DATE' 17 JAN 68    COLOSSUS GSOP CHANGES.
R0008   MOD NO' 3           MOD BY' RR BAIRNSFATHER      DATE'  8 MAY 68    DELETE CMSM MANEUVER (PCR 50)
R0010   FUNCTION'           TO CALCULATE AND DISPLAY EMS INITIALIZATION DATA
R0011   CALLING SEQUENCE-   BY V37
R0012   EXIT-               TO P62
R0013   SUBROUTINE CALLS-   S61.1 , S61.3 , GOFLASH , PLAGUP , R02BOTH

R0014   ERASABLE INITIALIZATION'
R0015           EMSALT  (-29) M       .05G ALTITUDE ABOVE FISCHER ELLIPSOID   PAD LOADED.
R0017           ALFAPAD  /180         HYPERSONIC CM TRIM ANGLE OF ATTACK      PAD LOADED
R0019   OUTPUT' THE FOLLOWING REGISTERS ARE WRITTEN IN FOR USE BY DISPLAYS
R0020           GMAX   100 GMAX (-14) G,S     MAXIMUM ACCELERATION
R0021           VPRED  (-7)  M/CS     PREDICTED VELOCITY AT 400K FT
R0022           GAMMAEI  GAMMA/360    PREDICTED GAMMA    AT 400K FT
R0023           RTGO   THETAH/360     RANGE ANGLE TO SPLASH FROM EMSALT       EMSALT IS PAD LOADED
R0025           VIO    (-7) M/CS      INERTIAL VELOCITY AT      EMSALT       EMSALT IS PAD LOADED
R0027           TTE    (-28) CS       TIME     TO               EMSALT       EMSALT IS PAD LOADED
R0029           LAT(SPL)  /360        TARGET LOCATION                         LEFT BY DSKY
R0031           LNG(SPL)  /360        TARGET LOCATION                         LEFT BY DSKY
R0033           HEADSUP   (0)         +1 = LIFT DOWN,  -1 = LIFT UP           LEFT BY DSKY
R0035   DEBRIS' SEE SUBROUTINES.

 0036                          26,2217                    BANK   26
 0037   REF  1                 26,2000                    SETLOC P60S
 0038                          26,2217                    BANK

 0039   REF 15  LAST 530       E6,1661                    EBANK= ACC

 0040   REF  1                                            COUNT* $$/P61

 0041   REF 41  LAST 692       26,2217  3 4875 1  P61     CA     BIT14       EXTENDED VERB SHOULD BE FREE THIS CLOSE
 0042   REF 18  LAST 560       26,2220  55=044 1          TS     EXTVBACT    TO V37
A0043                                                                       LOCK OUT EXTENDED VERBS SO CAN USE TPF
A0044                                                                       ROUTINES.EXT VERB ERASE IS USED

 0045   REF 89  LAST 889       26,2221  4 4712 0          CS     ONE         REMOVE IF HEADSUP EVER ON UPLINK DATA
 0048   REF  3  LAST 275       26,2222  55=728 1          TS     HEADSUP     PRELOAD

 0047   REF  1                 26,2223  0 2543 1          TC     S61.1       CHECK STATE VECTOR AND IMU ORIENTATION
A0048                                                                            RV 80GENRET. DOES PHASCHNG, GROUP 4.

 0049   REF  1                 26,2224  3 2424 1          CA     V08N81      LAT(SPL)     LNG(SPL)     HEADSUP
A0050                                                                           XXX.XX DEG   XXX.XX DEG   XXXXX.
 0051   REF 221 LAST 737       26,2225  0 4555 0          TC     BANKCALL
 0052   REF 17  LAST 727       26,2226   20763 1          CADR   GOFLASHR
 0053   REF 62  LAST 737       26,2227  0 4106 1          TC     GOTOPOOH
```

```
0054  REF   1                 26,2230  0 2235 1             TC      P61.4
0055                          26,2231  0 2224 1             TC      -5

0056  REF  75  LAST  724      26,2232  0 5301 0  P61.3      TC      PHASCHNG
0057                          26,2233   00014 1             OCT     00014

0058  REF  96  LAST  727      26,2234  0 5112 0             TC      ENDOFJOB

0061                          26,2235  22 007 0  P61.4      ZL
0062  REF   4  LAST  743      26,2236  11∝726 1             CCS     HEADSUP
0063  REF  42  LAST  743      26,2237  3 4675 1             CA      BIT14
0064                          26,2240  12 241 0             NOOP
0065  REF   5  LAST  276      26,2241  53∝716 1             DXCH    ROLLC

0066  REF 194  LAST  738      26,2242  0 6006 1             TC      INTPRET
0067                          26,2243   77745 1  NEWRNVN     DLOAD
0068  REF   9  LAST  660      26,2244   01205 1             PIPTIME
0069  REF   2  LAST  116      26,2245   37651 1             STCALL  MM
0070  REF   1                 26,2246   52063 0             STARTEN1
0071                          26,2247   77775 1             VLOAD
0072  REF  11  LAST  660      26,2250   01171 1             RN
0073  REF  15  LAST  635      26,2251   02327 0             STORE   RONE
0074                          26,2252   77656 1             UNIT
0075  REF   1                 26,2253   26343 1             STOVL   URONE
0076  REF  10  LAST  656      26,2254   01177 1             VN
0077  REF  10  LAST  513      26,2255   02335 0             STORE   VONE
0078                          26,2256   53435 0             VXV     UNIT
0079  REF   2  LAST  744      26,2257   02343 1             URONE
0080  REF   2  LAST  116      26,2260   03502 0             STORE   UNI
0081                          26,2261   45345 1  DUMPP61    DLOAD   DSU
0082  REF   3  LAST  744      26,2262   03651 0             MM
0083  REF  10  LAST  744      26,2263   01205 1             PIPTIME
0084                          26,2264   45040 1             BVN     CALRB
0085  REF   1                 26,2265   54243 0                     NEWRNVN
0086  REF   1                 26,2266   54650 0                     S61.2
A0087
0089  REF   5  LAST  736      26,2267  0 5425 1  P61.1      TC      CLEARMRK
0090  REF   1                 26,2270  3 2423 0             CA      V06N60
A0091
0092  REF 222  LAST  743      26,2271  0 4555 0             TC      BANKCALL
0093  REF  37  LAST  737      26,2272   20624 0             CADR    GOFLASH

0094  REF  63  LAST  743      26,2273  0 4106 1             TC      GOTOPOOH
0095  REF   1                 26,2274  0 2276 0             TC      P61.2
0096                          26,2275  0 2270 0             TC      -5

0097  REF 195  LAST  744      26,2276  0 6006 1  P61.2      TC      INTPRET
A0098
0099                          26,2277   45234 0             RTB     DSU
0100  REF  23  LAST  732      26,2300   45505 0                     LOADTIME
```

C(HEADSUP)= +1/-1
IF HEADSUP POS,ROLLC =160 DEG.(LIFT DWN)
IF HEADSUP NEG,ROLLC=0 (LIFT UP)
ROLLC IS USED BY S62.3' GIM ANG AT .05G

SAVE TIME OF RN,VN TO DETERMINE IF AN
UPDATE HAS OCCURRED
INITIALIZE

INITIAL VALUE OF PIPTIME

UPDATED... GO TRY AGAIN
GET DISPLAY DATA FOR N60 AND N63
AND RETURN IN BASIC, BELOW.

GMAX	VPRED	GAMMAE$_1$
XXX.XX G	XXXXX. FPS	XXX.XX DEG

PROCEED

CORRECT TIE FOR TIME LAPSE DURING
ABOVE DISPLAY.

CURRENT TIME.

L P61-P67 USER'S PAGE NO. 3 E6 S3

```
 0101   REF   4  LAST  744   26,2301   03651 0            MM          PIPTIME FOR RONE d VONE.
 0102                        26,2302   77615 0      DAD
 0103   REF   2  LAST  116   26,2303   03733 0                  TIE1  NEGATIVE OF FREE FALL TIME.
 0104   REF   5  LAST  275   26,2304   03727 0      STORE       TIE   DECREMENTED

 0105                        26,2305   77776 1      EXIT

 0106   REF   1              26,2306   3 2425 0     CA          V06N63      RTGO          VIO           TIE
A0107                                                                      XXXX.X NM     XXXXX. FPS    XXBXX M,S
 0108   REF 223  LAST  744   26,2307   0 4555 0     TC          BANKCALL
 0109   REF  36  LAST  744   26,2310    20624 0     CADR        GOFLASH
 0110   REF  64  LAST  744   26,2311   0 4106 1     TC          GOTOPOOH
 0111                        26,2312   0 2314 0     TC          +2
 0112   REF   2  LAST  744   26,2313   0 2276 0     TC          P61.2       REDO

R0113                                    .... THEN FALL INTO P62
```

```
R0114  PROGRAM-              P62
R0115  MOD NO.-              0    MAR. 13, 1967
R0116  MOD BY-               R. HIRSCHKOP
R0117  MOD NO' 1             MOD BY' RR BAIRNSFATHER     DATE' 21 MAR 67
R0118  MOD NO' 2             MOD BY' RR BAIRNSFATHER     DATE' 22 JUN 67     RESTARTS.
R0120  MOD NO' 3             MOD BY' RR BAIRNSFATHER     DATE' 17 JAN 68     COLOSSUS GSOP CHANGES.
R0122  MOD NO' 4             MOD BY' RR BAIRNSFATHER     DATE'  6 MAY 68     MOVE START OF DESIRED GIMBAL CALC.
R0124  FUNCTION-             1) TO NOTIFY CREW WHEN GNC SYSTEM IS PREPARED FOR CM/SM SEPARATION
R0126                        2) TO ORIENT THE CM TO THE CORRECT ATTITUDE FOR ATMOSPHERIC ENTRY
R0126  CALLING SEQUENCE-     BY V37 OR DIRECTLY FROM P61
R0129  EXIT-                 TO P63
R0130  ERASABLE INITIALIZATION'
R0131          ALFAPAD                                   LEFT BY PAD LOAD
R0132          LADPAD                                    LEFT BY PAD LOAD
R0133          LODPAD                                    LEFT BY PAD LOAD
R0134          LAT(SPL)      (MAY BE CHANGED BELOW)      LEFT BY DSKY, VIA P61
R0136          LNG(SPL)      (MAY BE CHANGED BELOW)      LEFT BY DSKY, VIA P61
R0138          HEADSUP       (MAY BE CHANGED BELOW)      LEFT BY DSKY, VIA P61
R0140  SUBROUTINE CALLS'     NEWMODEX , S61.1 , CM/DAPIC , CM/DAPON , R02BOTH , GOPERF1 , GOFLASH , GODSPR

 0142  REF  1                                  COUNT* $$/P62

 0143  REF  7  LAST  527   26,2314  0 5243 1        TC     NEWMODEX      MODE CHANGE IF CAME FROM P61.
 0144                       26,2315   00076 0       MM     62            MODE CHANGE AUTOMATIC VIA V 37.
 0145  REF 90  LAST  743   26,2316  3 4712 1        CA     ONE
 0146  REF  4  LAST  196   26,2317  54 332 1        TS     DNLSTCOD

 0147  REF  2  LAST  743   26,2320  0 2543 1  P62   TC     S61.1         CHECK STATE VECTOR AND IMU ORIENTATION.

 0148  REF 196 LAST  744   26,2321  0 6006 1        TC     INTPRET
 0149                       26,2322   47131 1       SSP    RTB
 0150  REF  2  LAST  110   26,2323   03325 0               POSEXIT
 0151  REF  1               26,2324   54402 0               P62.3         CALCULATE DESIRED .05G GIMBAL ANGLES,
A0152                                                                     WITHOUT DISPLAY.
 0153  REF  1               26,2325   41645 0               CM/DAPIC      START CM/POSE AND BODY RATE CALC

A0154
A0155                                                 DOES 2PHSCHNG, OCT 40116, OCT 05024, OCT 13000.
                                                      CM/DAPIC SETS EBANK = EBANK6

A0156                                                 AND RETURNS IN BASIC TO P62.2.
 0157                      26,2326  0 0006 1  P62.2  EXTEND
 0158  REF  1              26,2327  3 2431 0        DCA    POSECADR      CONTINUE WITH CM/POSE AFTER AV G.
 0159  REF  8  LAST  647   26,2330  53=223 1        DXCH   AVEGEXIT

 0160  REF  1              26,2331  3 4270 0        CAF    OCT41         REQUEST SEPARATION
 0161  REF 224 LAST  745   26,2332  0 4555 0        TC     BANKCALL
 0162  REF  1              26,2333   21031 0        CADR   GOPERF1R
 0163  REF 65  LAST  745   26,2334  0 4106 1        TC     GOTOPOOH
 0164                      26,2335  0 2340 1        TC     +3            PROCEED
```

```
A0165                                                          NOTE' NODOFLAG WILL BE SET IN CM/DAPON. ±±±
 0166                          26,2336  0 2331 1        TC     -5          ENTER
 0167  REP   1                26,2337  0 2232 0        TC     P61.3       FOR PHASCHNG AND ENDOFJOB.

 0168  REP  44  LAST  690      26,2340  0 4574 0  +3    TC     POSTJUMP
 0169  REP   1                26,2341   41585 1        CADR   CM/DAPON    DISABLE RCS DAP, ENABLE ENTRY DAP AND
A0170                                                                     DO ATTITUDE HOLD.

A0171                                                          WILL IDLE UNTIL CM/POSE DOES ONE UPDATE.
A0172                                                          CM/DAPON DOES NO PHASCHNG.
 0173  REP   2  LAST  743      26,2342  3 2424 1  P62.1  CA     V06N61      LAT(SPL)    LNG(SPL)    HEADSUP
A0174                                                                     XXX.XX DEG  XXX.XX DEG  0000X.

A0175                                                          TERMINATE ATTITUDE HOLD. SET UP COMMANDS'
A0176                                                          ROLLC, ALFACOM, BETACOM.  BEGIN MANUVER TO
A0177                                                          ENTRY ATTITUDE.

 0178  REP 225  LAST  746      26,2343  0 4555 0        TC     BANKCALL
 0179  REP  39  LAST  745      26,2344   20824 0        CADR   GOFLASH
 0180                          26,2345  0 2342 0        TC     -3
 0181                          26,2348  0 2350 0        TC     +2
 0182                          26,2347  0 2342 0        TC     -5

 0183  REP  76  LAST  744      26,2350  0 5301 0        TC     PHASCHNG
 0184                          26,2351   04024 0        OCT    04024       USE ENTRYVN FOR DISPLAY BELOW.

A0185                                                                    BRANK WAS SET IN CM/DAPON TO BRAKG

 0186  REP   5  LAST  744      26,2352  11∝726 1        CCS    HEADSUP     C(HEADSUP) = +/- 1
 0187  REP  43  LAST  744      26,2353  3 4875 1        CA     BIT14       IF HEADSUP POS,ROLLC=180 DEG (LIFT DWN)
 0186                          26,2354  12 355 1        NOOP               IF HEADSUP NEG,ROLLC=0 DEG  (LIFT UP)
 0189  REP   6  LAST  744      26,2355  55∝715 1        TS     ROLLC
 0190  REP   1                26,2356  3 1411 1        CA     ALFAPAD     NOMINAL ALFATRIM PAD LOADED, NEG. NO.
 0191                          26,2357  22 007 0        ZL
 0192  REP   2  LAST  110      26,2360  53∝804 0        DXCH   ALFACOM     SET ALFACOM = ALFA TRIM, BETACOM=0

 0193  REP  91  LAST  746      26,2361  3 4712 1        CA     ONE         PERMITS EXDAP2 TO CHANGE FLAG TO +0
 0194  REP   1                26,2362  55∝727 0        TS     P63FLAG     AS INDICATOR. STARTS UP P63.

 0195  REP   2  LAST  391      26,2383  3 4745 0        CA     V06N22      SET UP DISPLAY FOR CDU DESIRED VALUES
 0196  REP   2  LAST   78      26,2364  55∝263 0        TS     ENTRYVN     FROM ENTRY ATTITUDE CALC, THAT IS
A0197                                                                    ALREADY GOING.
 0198  REP  44  LAST  699      26,2365  0 5435 0        TC     UPFLAG      TURN ON ENTRY DISPLAY
 0199  REP   1                26,2366   00134 1        ADRES  ENTRYDSP    ENTRYDSP = 92D  BIT 13  FLAG 6
A01991                                          SKIP
```

L P61-P67

USER=S PAGE NO. 6 E6 S3

```
 0200  REF   4  LAST  173   26,2367  4 1700 0            CS     CMDAPMOD      GO DIRECTLY TO P63 IF BODY ATTITUDE
 0201  REF  92  LAST  747   26,2370  7 4712 0            MASK   ONE           IS SUCH THAT THE DELAY TASK' WAKEP62
 0202                       26,2371  0 0006 1            EXTEND               WILL BE OMITTED.
 0203  REF   1              26,2372  1 2420 1            BZF    P63.1         DISABLE GRP 4, GO TO ENDOFJOB.

A0204
 0205  REF   1              26,2373  0 2406 1            TC     P63           (IE, CONTINUE IF CMDAPMOD = -1, OR +0)

A0206                                                                        PUT JOB TO SLEEP UNTIL VEHICLE MANUVER HAS
A0207                                                                        REDUCED ALFA TO +/-45 DEG. CONSIDER REMAINING
A0208                                                                        65 DEG (25 DEG IF ALFA NEG) TO ALFA TRIM TO
A0209                                                                        OCCUR AT 3 DEG/SEC, AND TERMINATE P62 AT THAT
A0210                                                                        TIME.
A0211                                                                        TASK WAKEP62 IS CALLED FROM ENTRY DAP.

 0212  REF   2  LAST  610   26,2374  3 4760 1  WAKEP62   CA     PRIO13
 0213  REF  24  LAST  663   26,2375  0 5027 1            TC     NOVAC
 0214  REF  16  LAST  743   E6,1661                      EBANK= ACG
 0215  REF   2  LAST  746   26,2376   02406 1           2CADR  P63
 0215                       26,2377   54066 0
 0216  REF  40  LAST  667   26,2400  0 5213 1            TC     TASKOVER

 0217  REF   2  LAST  746   26,2401   54402 0  P62.3CAD CADR   P62.3

A0218
A0219                                                                        EACH 2 SEC, CALCULATE GIMBAL ANGLES FOR ENTRY CON-
A0220                                                                        DITIONS THAT WILL HOLD IF REORIENTATION WERE MADE
A0221                                                                        AT PRESENT RN, VN. COME HERE FROM CM/POSE AND ALSO
 0222                                                                        IN KEPLER PHASE OF ENTRY.
                           26,2402   52131 0  P62.3     SSP    GOTO          SET RETURN ADDRESS SO THAT  ROUTINE
 0223  REF  16  LAST  726  26,2403   00053 1                   QPRET         GOES DIRECTLY TO ENTRY GUIDANCE EXIT
 0224  REF   1              26,2404   53570 0                   ENDEXIT       THAT DOES ENTRY DISPLAY ,GRP 5.
 0225  REF   1              26,2405   20302 1                   S62.3          PUT DESIRED CDU VALUES IN CPHI=S FOR
A0226                                                                        N22 DISPLAY.
```

```
P0227                P63
R0228   PROGRAM-            P63
R0229   MOD NO.-            0    MAR. 13, 1967
R0230   MOD BY-             R. HIRSCHKOP
R0231   MOD NO' 1           MOD BY' RR BAIRNSFATHER      DATE' 22 JUN 67    RESTARTS.
R0233   MOD NO' 2           MOD BY' RR BAIRNSFATHER      DATE' 14 JUL 67    REVISED RESTARTS
R0235   FUNCTION-           1) TO INITIALIZE THE ENTRY EQUATIONS
R0236                       2) TO CONTINUE TO HOLD THE CM TO THE CORRECT ATTITUDE WITH RESPECT TO THE ATMOSPHERE FOR
R0238                          THE ONSET OF ENTRY DECELERATION. ROLL ANGLE IS LIFT UP/DOWN AS SPECIFIED BY HEADSUP.
R0240                       3) TO SENSE .05 G
R0241   CALLING SEQUENCE-   DIRECTLY FROM P62
R0242   EXIT-               TO ENDOFJOB
R0243   SUBROUTINE CALLS-   NEWMODEX , GODSPR

 0244   REF   1                                                  COUNT* $$/P63

 0245   REF   8  LAST 746   26,2406  0 5243 1  P63     TC     NEWMODEX
 0246                       26,2407   00077 1           MM     63

 02461  REF 226  LAST 747   26,2410  0 4555 0          TC     BANKCALL      FLUSH N22 DISPLAY, IF ON. (ONIT DISP
 02462  REF   8  LAST 736   26,2411   20607 1          CADR   CLEANDSP      DURING STARTENT PASS.)

A0247                                                                     ARRIVE WITH EBANK = A0G.

 0248   REF   1             26,2412  3 2427 1          CA     ENTCADR       CONTINUE AT STARTENT AFTER CM/POSE .

A0249                                                          AT END OF STARTENT, CHANGE ADDRESS IN GOTOADDR
A0250                                                          TO CONTINUE AT  SCALEPOP  THEREAFTER.

 0251   REF   3  LAST 746   26,2413  55=724 0          TS     POSEXIT

 0252   REF   1             26,2414  3 2426 0          CA     V06N64        G          VI          R TO SPLSH
A0253                                                                     XXX.XX G   XXXXX. FPS   XXXX.X NM
 0254   REF   3  LAST 747   26,2415  55=263 0          TS     ENTRYVN       FOR DISPLAY CALL IN OVERNOUT.

 02541  REF  93  LAST 748   26,2416  4 4712 0          CS     ONE           IN CASE FLAG IS LEFT AT +1 BY DAP. THE
 02542  REF   2  LAST 747   26,2417  55=727 0          TS     P63FLAG       -1 ASSURES THAT EXO-ATM DAP WILL NOT
A02543                                                                    CALL P63 OUT OF SEQUENCE IN P66 .

 0255   REF  77  LAST 747   26,2420  0 5301 0  P63.1   TC     PHASCHNG
 0256                       26,2421   00004 0           OCT    00004         DISABLE. DISPLAY RESTARTED VIA ENTRY.

 0257   REF  97  LAST 744   26,2422  0 5112 0          TC     ENDOFJOB

 0258                       26,2423   01474 1  V06N60   VN     0660
 0259                       26,2424   01475 0  V06N61   VN     0661
 0260                       26,2425   01477 1  V06N63   VN     0663
 0261                       26,2426   01500 0  V06N64   VN     0664
 0262   REF   1             26,2427   52000 0  ENTCADR  CADR   STARTENT
```

L P61-P67

USER=S PAGE NO. 8 E6 S3

```
0263  REP  6  LAST  289   E7,1451                          EBANK= RTINIT
0264  REP  1               26,2430   03373 0  POSECADR 2CADR  CM/POSE
0264  REP  1               26,2431   76067 1
```

TO CARY OVER INTO ENTRY STEERING.

```
P0265  PROGRAM-              P64
R0266  MOD NO.-              1     SEPT. 19, 1967
R0267  MOD BY-               R. HIRSCHKOP
R0268  MOD NO' 2             MOD BY' RR BAIRNSFATHER     DATE' 8 MAY 68     REVISED COMMENTS FOR COLOSSUS
R0270  FUNCTION-             1. TO START ENTRY GUIDANCE AT .05G SELECTING ROLL ATTITUDE, CONSTANT DRAG LEVEL, AND
R0272                        DRAG THRESHOLD, KA , WHICH ARE KEYED TO THE .05G POINT.
R0274                        2. SELECT FINAL PHASE P67 IF V ± 27000 FPS WHEN .2G OCCURS.
R0276                        3. ITERATE FOR UP-CONTROL SOLUTION  P65  IF V δ 27000 FPS AND IF ALTITUDE RATE AND DRAG
R0278                        LEVEL CONDITIONS ARE SATISFIED. ENTER P65 WHEN CONSTANT DRAG CONTROLLER HAS BROUGHT RANGE
R0280                        AS PREDICTED TO WITHIN 25 NM OF DESIRED RANGE.
R0281                        4. SELECT FINAL PHASE  P67  IF NO UP-CONTROL SOLUTION EXISTS WITH VL δ 18000 FPS.
R0283  CALLING SEQUENCE-     BY RTB FROM REENTRY CONTROL
R0284  EXIT-                 BACK TO REENTRY CONTROL
R0285  SUBROUTINE CALLS-     NEWMODEX
 0286                        26,2432                    BANK   26
 0287  REF  1                26,2000                    SETLOC P60S1
 0288                        26,2432                    BANK

R0289          THIS DISPLAY IS CALLED EACH PASS THROUGH STEERING. RESTART PROTECTION IS VIA STEERING.

 0291  REF  1                                           COUNT* $$/P64

 0292  REF  9  LAST 749      26,2432  0 5243 1  P64     TC     NEWMODEX    ENTER VIA RTB WHEN .05G IS EXCEEDED.
 0293                        26,2433   00100 0          MM     64
 0294  REF  1                26,2434  3 2437 0          CA     V06N68      ROLLC          VI             HDOT
A0295                                                                     XXX.XX DEG     XXXXX. FPS     XXXXX. FPS
 0296  REF  4  LAST 749      26,2435  55∝263 0          TS     ENTRYVN     DISPLAY VIA OVERNOUT.

 0297  REF  7  LAST 724      26,2436  0 6030 1          TC     DANZIG      ... AND CONTINUE IN INITROLL ...
 0298                        26,2437   01504 1  V06N68  VN     0668
```

```
P0299  PROGRAM'                 P65
R0300  MOD NO' 0                MOD BY' RR BAIRNSFATHER     DATE' 17 JAN 66     COLOSSUS GSOP ADDITION.
R0302  FUNCTION'                TO CONTINUE ENTRY GUIDANCE, USING THE UP-CONTROL PHASE TO STEER TO A CONTROLLED EXIT
R0304                           CONDITION. THIS PHASE TERMINATES  A) IF D  ± Q7 FPSS, GO TO P66    ,
R0306                                                             B) IF RDOT NEG, AND IF V ± VL +500FPS, GO TO P67.
R0308
R0309  CALLING SEQUENCE'        BY RTB FROM REENTRY CONTROL
R0310  EXIT'                    BACK TO REENTRY CONTROL, OR TO ENDOFJOB.
R0311  SUBROUTINE CALLS'        NEWMODEX

 0312  REF  1                                                  COUNT* $$/P65

 0313  REF  10  LAST  751   26,2440  0 5243 1  P65     TC     NEWMODEX     ENTER VIA RTB WHEN RANGE ± 25 N M OF
 0314                       26,2441   00101 1          MM     65           TARGET.

 0315  REF   3  LAST  746   26,2442  3 4760 1          CA     PRIO13
 0316  REF  25  LAST  746   26,2443  0 5027 1          TC     NOVAC
 0317  REF   5  LAST  751      1263                    EBANK= ENTRYVN
 0318  REF   2  LAST  210   26,2444   02456 1          2CADR  P65.1
 0318                       26,2445   54062 1
 0319  REF  24  LAST  665   26,2446  0 5261 1          TC     2PHSCHNG     2 PHASE CHG REQUIRED TO PREVENT RE-
 0320                       26,2447   00554 0          OCT    00554        STARTING FLASHING DISPLAY TWICE.
 0321                       26,2450   10035 0          OCT    10035        4.55 SPOT AND SERVICER, HERE.
 0322  REF 197  LAST  746   26,2451  0 6006 1          TC     INTPRET
 0323                       26,2452   47131 1          SSP    RTB
 0324  REF   2  LAST  116   26,2453   03646 0                 GOTOADDR     CHANGE ENTRY MODE TO UPCONTRL.
 0325  REF   1                26,2454   53027 1                 UPCONTRL
 0326  REF   1                26,2455   52120 0                 REFAZE10     GO HERE TO REESTABLISH ENTRY SEQUENCER.
A0327                                                                       AND CONTINUE AT UPCONTRL...

 0328  REF  49  LAST  700   26,2456  0 5447 0  P65.1   TC     DOWNFLAG
 0329  REF   2  LAST  747   26,2457   00134 1          ADRES  ENTRYDSP     ENTRYDSP = 92D  BIT 13 FLAG 6
A03291
 0330  REF   1                26,2460  3 2472 1          CA     V16N69       ROLLC        DL  (Q7)      VL
 0331  REF 227  LAST  749   26,2461  0 4555 0          TC     BANKCALL     XXX.XX DEG   XXX.XX G     XXXXX. FPS
 0332  REF  16  LAST  743   26,2462   20763 1          CADR   GOFLASHR
 0333                       26,2463  0 2460 1          TC     -3           NODOFLAG IS SET..
 0334                       26,2464  0 2467 0          TC     +3
 0335                       26,2465  0 2460 1          TC     -5
 0336  REF   2  LAST  747   26,2466  0 2232 0          TC     P61.3        EST. GRP 4 FOR DSPLAY AND DO ENDOFJOB
A0337                                                                       IF PROCEED, CONTINUE.
 0338  REF  45  LAST  747   26,2467  0 5435 0          TC     UPFLAG
 0339  REF   3  LAST  752   26,2470   00134 1          ADRES  ENTRYDSP     ENTRYDSP = 92D  BIT13 FLAG 6
A03391
 0340  REF   2  LAST  746   26,2471  0 2420 0          TC     P63.1        DISABLE GRP 4,START UP ENTRY DISPLAY

A0341                                                                      N06V66 VIA OVERNOUT, AS USED IN P64.

 0342                       26,2472   04105 1  V16N69  VN     1669
```

```
P0343  PROGRAM'          P66
R0344  MOD NO' 0         MOD BY' RR BAIRNSFATHER     DATE' 17 JAN 66     COLOSSUS GSOP ADDITIONS.
R0346  FUNCTION'         KEEP CM ATTITUDE IN TRIM TO THE RELATIVE VELOCITY VECTOR. ENTRY GUIDANCE STOPS GENERATING
R0348                    ROLL COMMANDS UNTIL DRAG BUILDS UP TO Q7+0.5 FPSS.
R0349
R0350  CALLING SEQUENCE'  VIA RTB FROM REENTRY CONTROL.
R0351  EXIT'             BACK TO REENTRY CONTROL.
R0352  SUBROUTINE CALLS' NEWMODEX

 0353  REP  1                                          COUNT* $$/P66

 0354  REP  11  LAST  752  26,2473  0 5243 1  P66     TC     NEWMODEX     ENTER VIA RTB WHEN D ± Q7 FPSS
 0355                       26,2474   00102 1          MM     66

 0356  REP  3   LAST  747  26,2475  3 4745 0          CA     V06N22       OGA          IGA          MGA
A0357                                                                    XXX.XX DEG   XXX.XX DEG   XXX.XX DEG
 0358  REP  1              26,2476  0 2502 1          TC     P66END       IN CASE CAME FROM P65, GO DISABLE GRP4,
A0359                                                                    AND SET ENTRYDSP TO DO DISPLAY VIA
A0360                                                                    OVERNOUT.
A0361                                                                    ... AND CONTINUE AT KEP2
```

```
P0362   P67

R0363   PROGRAM-            P67
R0364   MOD NO.-            0    MAR. 16, 1987
R0365   MOD BY-             R. HIRSCHKOP
R0366   FUNCTION-           TO TERMINATE STEERING WHEN THE CM VELOCITY WRT EARTH = 1000 FT/SEC
R0368   CALLING SEQUENCE-
R0369   EXIT-               TO POOH
R0370   SUBROUTINE CALLS-   GOFLASH
R0371           THIS DISPLAY IS CALLED EACH PASS THROUGH STEERING. RESTART PROTECTION IS VIA STEERING.

 0373   REP  1                                                  COUNT* $$/P67

 0374   REP 12 LAST 753   26,2477  0 5243 1  P67      TC     NEWMODEX      ENTER VIA RTB
 0375                     26,2500   00103 0           MM     67
 0378   REP  1            26,2501  3 2510 1           CA     V06N86        ROLLC        XRNGERR      DNRNGERR
A0377                                                                      XXX.XX DEG   XXXX.X NM    XXXX.X NM
 0378   REP  6 LAST 752   26,2502  55=263 0  P88END   TS     ENTRYVN       DISPLAY VIA OVERNOUT.

 0379   REP 46 LAST 752   26,2503  0 5435 0          TC     UPFLAG        (IN CASE CAME FROM P85. ENTRY DISPLAY
 0380   REP  4 LAST 752   26,2504   00134 1          ADRES  ENTRYDSP      WILL FLUSH FLASHING DISP. IF STILL ON)
A03802                                                                     BIT 13 FLAG 6
 0381   REP 78 LAST 749   26,2505  0 5301 0  KILLGRP4 TC     PHASCHNG      DISABLE GRP4, IN CASE CAME FROM HUNTEST.
 0382                     26,2506   00004 0           CCT    00004         (COME TO KILLGRP4 VIA RTB,RET TO CALLER)

 0383   REP  8 LAST 751   26,2507  0 8030 1          TC     DANZIG        ... AND CONTINUE AT PREDICT3 ...

 0384                     26,2510   01502 1  V08N86   VN     0688

 0385                     26,2511                    BANK   26
 0386   REP  1            26,2000                    SETLOC P60S2
 0387                     26,2511                    BANK

 0388   REP  1            26,2511  3 2542 0  P67.1    CA     V16N87        RTOGO        LAT          LONG
A0389                                                                      XXXX.X NM    XXX.XX DEG   XXX.XX DEG
 0390   REP 228 LAST 752  26,2512  0 4555 0          TC     BANKCALL
 0391   REP  40 LAST 747  26,2513   20824 0          CADR   GOFLASH
 0392                     26,2514  0 2517 0          TC     +3            EFFECTIVE GOTOPOOH
 0393                     26,2515  0 2517 0          TC     +2
 0394   REP  2 LAST 209   26,2518  0 2511 0          TC     P67.1         REDO

 0395   REP 25 LAST 895   26,2517  4 6214 1          CS     THREE         TURN OFF ENTRY DAP
 0398                     26,2520  0 0004 0          INHINT
 0397   REP  1            26,2521  7 0102 0          MASK   CM/FLAGS      CM/DSTBY , GAMDIFSW
 0398   REP  2 LAST 754   26,2522  54 102 0          TS     CM/FLAGS
 0399                     26,2523  0 0003 1          RELINT
 0400                     26,2524  0 0006 1          EXTEND
 0401   REP  1            26,2525  3 2642 0          DCA    SERVCAD2
```

L P61-P67 USER'S PAGE NO. 13 E6 S3

```
0402  REF   9  LAST  746   26,2526  53'223 1          DXCH   AVEGEXIT
0403  REF  66  LAST  746   26,2527  1 4106 0          TCF    GOTOPOOH
```

```
0404
0405  REP  12  LAST  744    26,2530  43175 0  P67.2   VLOAD   CLEAR
                            26,2531  01171 1                  RN
0406  REP   9  LAST  702    26,2532  00662 0                  ERADFLAG
0407  REP  11  LAST  730    26,2533  16152 0          STODL   ALPHAV
0408  REP  11  LAST  744    26,2534  01205 1                  PIPTIME
0409                        26,2535  45014 0          CLEAR   CALL
0410  REP  18  LAST  702    26,2536  01663 0                  LUNAFLAG
0411  REP   5  LAST  696    26,2537  26322 0                  LAT-LONG
0412                        26,2540  77634 0  P67.3   RTB
0413  REP   1                26,2541  53603 1                  SERVNOUT
0414
                            26,2542  04103 1  V16N67  VN      1667
0415  REP   2  LAST  366       4270           OCT41   =       33DEC
0416  REP   1                26,2641          SERVCAD2 =      SERVCAD1
```

CALC PRESENT LAT, LONG, ALT.

USE PAD RAD FOR ALT.(NOT SEEN ANYWAY)

USE TIME OF RN

ENTRY EXIT THAT OMITS DISPLAY.

```
P0417  SUBROUTINE NAME'     S61.1
R0418  MOD NO'  0                                                    DATE'          21 FEB 67
R0420  MOD BY'  RR BAIRNSFATHER                                      LOG SECTION'   P61-P67
R0422  MOD NO'  1          MOD BY'  RR BAIRNSFATHER      DATE'  22 JUN 67     RESTARTS.
R0424  FUNCTIONAL DESCRIPTION'     CALLED BY BOTH P61 AND P62
R0425          FIRST,TEST TO SEE IF  AVERAGEG  IS ON. IF NOT, UPDATE THE STATE VECTOR TO PRESENT TIME + TOLERANCE
R0427          AND TURN ON  AVERAGEG  AT THAT TIME, AND CONTINUE.  OTHERWISE CONTINUE'  SEE IF  IMU Y AXIS IS
R0429          WITHIN 30 DEG OF V*R.  IF YES, EXIT SUBROUTINE S61.1.    IF NO,  SEE IF -Y AXIS OF IMU IS WITHIN
R0431          30 DEG OF V*R.   IF YES, DISPLAY ALARM'  01427   IMU REVERSED.
R0432                           IF NO, DISPLAY ALARM'  01426   IMU UNSATISFACTORY.
R0434          IN EITHER OF THESE LAST 2 CASES, WAIT  10 SEC  AND THEN EXIT SUBROUTINE  S61.1.

R0436  REMARK'             THERE WILL BE A SHORT 10 SEC DELAY IF AN ALARM EXIT IS TAKEN. THE DELAY FOR INTEGRATION IS
R0438                      AS SHORT AS CAN BE MADE, BUT IS ARBITRARY SINCE IT  DEPENDS ON THE AGE OF THE STATE VECTOR.

R0440  CALLING SEQUENCE'  CALL
R0441                        S61.1
R0442                    C(MPAC) UNSPECIFIED
R0443                    PUSHLOC UNSPECIFIED

R0444  SUBROUTINES CALLED'  LOADTIME, CSMPREC, TPAGREE,
R0445                       WAITLIST, JOBSLEEP, JOBWAKE, PREREAD, ALARM, GODSPR, BANKCALL, DELAYJOB
R0447  NORMAL EXIT MODES'   RVQ
R0448  ALARMS'  01426       IMU UNSATISFACTORY
R0449           01427       IMU REVERSED
R0450  OUTPUT'  POSSIBLE ALARMS
R0451           POSSIBLY TDEC1, RATT, VATT, RN, VN
R0452  ERASABLE INITIALIZATION REQUIRED'
R0453           AVEGFLAG                AVERAGEG ON OR OFF                    LEFT BY SERVICER
R0455           PIPTIME  (-28) CS       TIME OF PIPA UPDATE                   LEFT BY READACCS
R0457           RN       (-29) M        STATE VECTOR                          LEFT BY AVERAGEG
R0459           VN       (-7) M/CS      STATE VECTOR                          LEFT BY AVERAGEG
R0461           REFSMMAT  (-1)          .5 REF TO SM MATRIX                   LEFT BY LAST IMU ALIGNMENT
R0463  DEBRIS'  QPRET
R0464           POSSIBLY PIPTIME1, RATT, VATT, TDEC1, RN1, VN1, QTEMP, X1     IF UPDATED
R0466           PUSH LIST LOCS USED BY CSMPREC

 0467  REF  17  LAST  748   E6,1661                  EBANK= ACG          FOR 60GENRET , S61DT
 0468                       26,2543                  BANK   26
 0469  REF   1              26,2000                  SETLOC P60S3
 0470                       26,2543                  BANK

 0471  REF   1                                       COUNT* $$/S61.1

 0472                       26,2543  0 0006 1  S61.1 EXTEND
 0473  REF   2  LAST  114   26,2544  23#773 0        QXCH   60GENRET     SAVE RET ADDR IN EB 6
 0474  REF 229  LAST  754   26,2545  0 4555 0        TC     BANKCALL
 0475  REF   7  LAST  695   26,2546   17573 0        CADR   R02BOTH
 0476  REF 198  LAST  752   26,2547  0 6006 1        TC     INTPRET
```

```
0477                                26,2550   45014 0                BON     CALRB
0478  REF   2  LAST  506            26,2551   00716 1                        AVEGFLAG      IS AVERAGEG ON
0479  REF   2  LAST  210            26,2552   54603 0                        S61.1A        YES
0480  REF   2  LAST  647            26,2553   27573 0                        MIDTOAV2      GET FUTURE STATE VECTOR SOON AS CAN

0481  REF 276  LAST  738            26,2554   3 0155 0               CA      MPAC +1       RETURN INHINTED ***
0482  REF   3  LAST  209            26,2555   55=774 0               TS      S61DT         FOR RESTART.
0483  REF  36  LAST  664            26,2556   0 5140 1               TC      WAITLIST
0484  REF  11  LAST  527            E7,1431                          EBANK=  DVCNTR
0485  REF   2  LAST  209            26,2557    02564 1               2CADR   S61.1C
0485                                26,2560    54067 1
0486  REF  79  LAST  754            26,2561   0 5301 0               TC      PHASCHNG
0487                                26,2562    40434 0               OCT     40434
0488  REF  96  LAST  749            26,2563   0 5112 0               TC      ENDOFJOB

0489  REF   4  LAST  752            26,2564   3 4760 1   S61.1C      CA      PRIO13
0490  REF  27  LAST  701            26,2565   0 5042 1               TC      FINDVAC
0491  REF  18  LAST  757            E6,1661                          EBANK=  ACC
0492  REF   3  LAST  758            26,2566    02602 1               2CADR   S61.1A -1
0492                                26,2567    54066 0

0493                                26,2570   0 0006 1               EXTEND
0494  REF   2  LAST  756            26,2571   3 2642 0               DCA     SERVCAD1      HE WHO STARTS AVERAGEG MUST SERVICE
0495  REF  10  LAST  755            26,2572   53=223 1               DXCH    AVEGEXIT      THE EXIT.

0496  REF  25  LAST  752            26,2573   0 5261 1               TC      2PHSCHNG
0497                                26,2574    00454 1               OCT     00454
0498                                26,2575    00415 1               OCT     00415

04981 REF   1                       26,2576   3 4753 1               CA      EBENTRY       SET EB= 7 FOR PREREAD.
04982 REF  33  LAST  661            26,2577   54 003 0               TS      EBANK

0499  REF  45  LAST  747            26,2600   0 4574 0               TC      POSTJUMP
0500  REF   3  LAST  649            26,2601    76604 1               CADR    PREREAD       PREREAD DOES TC TASKOVER.

0501  REF 199  LAST  757            26,2602   0 6006 1               TC      INTPRET
0502                                26,2603    77204 1   S61.1A      BOVB    VLOAD
0503  REF   2  LAST  289            26,2604    57343 1               TCDANZIG      TURN OFF OVFIND, IF ON
0504  REF  11  LAST  744            26,2605    01177 1               VN      (-7) M/CS
0505                                26,2606    64235 1               VXV     MXV
0506  REF  13  LAST  756            26,2607    01171 1               RN      RN (-29) M
0507  REF  28  LAST  731            26,2610    01736 1               REFSMMAT      .5 UNIT MATRIX.
0508                                26,2611    71256 0               UNIT    DLOAD
0509  REF 277  LAST  758            26,2612    00160 0               MPAC +3       GET COS(THETA)/2
0510                                26,2613    43240 0               RMN     DAD
0511  REF   1                       26,2614    54621 0               S61.1B        DO TEST ON -YSM
0512  REF   1                       26,2615    14644 1               C(30)LIM      = 1.0 -.5 COS(30)
0513                                26,2616    47004 0               BOVB    RTB
0514  REF   1                       26,2617    54640 1               RETRN1
0515  REF   1                       26,2620    54625 1               RETRN3
```

```
0516                                26,2621   43276 0  S61.1B   DCOMP   DAD
0517   REF   2  LAST  756           26,2622   14644 1           C(30)LIM    = 1.0- .5 COS(30)
0518                                26,2623   77404 1           BOVB    EXIT
0519   REF   1                     26,2624   54630 0           RETRN2

0520   REF  30  LAST  722           26,2625   0 5537 0 RETRN3   TC      ALARM
0521                                26,2626    01426 0          OCT     01426       IMU UNSATISFACTORY
0522   REF   2  LAST  759           26,2627   0 2632 1          TC      RETRN2 +2

0523   REF  31  LAST  759           26,2630   0 5537 0 RETRN2   TC      ALARM
0524                                26,2631    01427 1          OCT     01427       IMU REVERSED

0525   REF   4  LAST  697           26,2632   3 4743 0 +2       CAF     V05N09
0526   REF 230  LAST  757           26,2633   0 4555 0          TC      BANKCALL
0527   REF   3  LAST  699           26,2634    20602 1          CADR    GODSPR      DO DISPLAY
0528   REF   1                     26,2635   3 2645 1          CA      10SECS
0529   REF 231  LAST  759           26,2636   0 4555 0          TC      BANKCALL
0530   REF  11  LAST  700           26,2637    01732 0          CADR    DELAYJOB

0531   REF   3  LAST  757           26,2640   0 1773 0 RETRN1   TC      60GENRET

0532   REF  12  LAST  758           E7,1431                     EBANK=  DVCNTR
0533   REF   4  LAST  657           26,2641    03132 1 SERVCAD1 2CADR   SERVEXIT
0533                                26,2642    76067 1
0534                                26,2643    22111 0 C(30)LIM 2DEC    .566985     = 1.0 -.5 COS(30)
0534                                26,2644    17335 1
0535                                26,2645    01750 1 10SECS   DEC     1000        1000 CS
0536                                26,2646    00000 1 60SECDP  2DEC    6000 B-28   6000 CS
0536                                26,2647    13560 0
```

```
P0537

R0538   PROGRAM NAME'      S61.2                                          DATE'          14 FEB 67
R0540   MOD NO'  1                                                       LOG SECTION'   P61-P67
R0542   MOD BY'  MORTH / BAIRNSFATHER
R0543   MOD NO'  2          MOD BY'  MORTH/BAIRNSFATHER   DATE'  11 MAY 67    ADD 2ND ITER FOR ERAD AT 400K FT.
R0545   MOD NO'  3          MOD BY'  RR BAIRNSFATHER      DATE'  21 NOV 67    VARIABLE MU ADDED.
R0547   MOD NO'  4          MOD BY'  RR BAIRNSFATHER      DATE'  21 MAR 68    DIFFERENT EARTH/MOON SCALES IN TPF#S
R0549   FUNCTIONAL DESCRIPTION'      CALLED BY P61.  PROVIDES DISPLAYS FOR NOUNS N60 AND N63 .
R0551           PROGRAM CALCULATES ENTRY DISPLAY OF MAXIMUM ACCELERATION EXPECTED (GMAX)  AND ALSO THE EXPECTED
R0553           INERTIAL VELOCITY (VPRED) AND ENTRY ANGLE  (GAMMAEI)  THAT WILL OBTAIN AT 400K FT ABOVE THE FISCHER
R0555           ELLIPSOID.  PROGRAM ALSO CALCULATES A SECOND DISPLAY RELATIVE TO THE EMSALT ABOVE FISCHER ELLIPSOID
R0557           AND CONSISTS OF RANGE TO SPLASH FROM NOW (RTGO) , PREDICTED INERTIAL VELOCITY (VIO) , AND THE TIME TO
R0559           GO FROM NOW (TTE) .
R0560   CALLING SEQUENCE'  CALL
R0561                          S61.2
R0562           C(MPAC) UNSPECIFIED
R0563           PUSHLOC WILL BE SET TO ZERO.

R0564   SUBROUTINES CALLED'  TPFCONIC,  CALCTPF,  TPF/TRIG,  FISHCALC,  GETERAD,  VGAMCALC
R0566   NORMAL EXIT MODES,  RTB  P61.1
R0567   ALARMS'  NONE
R0568   OUTPUT'  THE FOLLOWING REGISTERS ARE WRITTEN IN FOR USE BY DISPLAYS
R0569           GMAX   100 GMAX  (-14)  G,S      MAXIMUM ACCELERATION
R0570           VPRED  (-7)  M/CS        PREDICTED VELOCITY AT 400K FT
R0571           GAMMAEI  GAMMA/360       PREDICTED GAMMA     AT 400K FT
R0572                                    FOR TM, DP(GAMMAEI) = (GAMMAEI, RTGO) / 360
R0574           RTGO   THETAH/360        RANGE ANGLE TO SPLASH FROM EMSALT       EMSALT IS PAD LOADED
R0576           VIO    (-7) M/CS         INERTIAL VELOCITY  AT      EMSALT       EMSALT IS PAD LOADED
R0578           TTE    (-28) CS          TIME      TO               EMSALT       EMSALT IS PAD LOADED

R0580           PUSHLOC = 0
R0581           CONIC PARAMETERS STORED IN VAC AREA (SEE TPF SUBROUTINES)
R0582   ERASABLE INITIALIZATION REQUIRED'
R0583           RONE   (-29) M           STATE VECTOR                           LEFT BY USER
R0585           VONE   (-7)  M/CS        STATE VECTOR                           LEFT BY USER
R0587           URONE  UR/2                                                     LEFT BY USER
R0589           UNI    (-1)              UNIT NORMAL V*R                        LEFT BY ENTRY / P61
R0591           THETAH  THETAH/360       RANGE ANGLE                            LEFT BY ENTRY / P61
R0593           UNITW  (0)               UNIT POLAR VECTOR                      LEFT BY  PAD LOAD
R0595           EMSALT  (-29) M          EMS INTERFACE ALTITUDE                 LEFT BY  PAD LOAD
R0597                                    ORBITAL REENTRY'  284643 FT,  LUNAR REENTRY'  297431 FT.
R0599   DEBRIS'  QPRET,
R0600           ALL PDL LOCATIONS ABOVE 12D, INCLUDING X1,X2,S1,S2
R0601           ALSO PDL+0  ...  PDL+5,  WHERE INITIAL PUSHLOC = PDL
```

```
P0602

R0603   THE FOLLOWING PUSH LIST LOCATIONS HAVE BEEN RESERVED FOR TPP ROUTINES AND ARE REPEATED HERE FOR CONVENIENCE.

R0605   OF COURSE  FOR S61.2 USAGE, EARTH ORIGIN SCALING IS USED.

A0606                                                    BELOW     E'   IS USED FOR EARTH ORIGIN SCALE
A0607                                                              M'   IS USED FOR MOON  ORIGIN SCALE

A0608                          RTERM   =     18D                   TERMINAL RADIUS M  E' (-29)  M' (-27)
A0609                          NRTERM  =     16D                   TERMINAL RADIUS M  E' (-29+NR)
A0610                                                                                   M' (-27+NR)
A0611                          RMAG1   =     12D                   PRESENT RADIUS M   E' (-29)  M' (-27)
A0612                          NRMAG   =     32D                   PRESENT RADIUS M   E' (-29+NR)
A0613                                                                                   M' (-27+NR)
A0614                          SDELP/2                             SIN(THETA)  /2
A0615                          CDELP/2 =     14D                   COS(THETA) /2
A0616                          TPPX    =     34D                   X, ARGUMENT OF SERIES T(X).
A0617                          TPPTEM  =     38D                   ARG  FOR TRANSFER ANGLE CALCULATION.
A0618                          TPPNP   =     28D                   LC.P  M  E' (-38+2NR)   M' (-38+2NR)
A0619                          TPP/RTMU =    30D                   1/SQRT(MU)          E' (17)   M' (14)
A0620                          TPPVSQ  =     20D                   -(VN.VN/MU)  I/M    E' (20)   M' (18)
```

L P61-P67 USER=S PAGE NO. 20 E6 S3

```
P0621

 0622                          34,3652                    BANK   34
 0623   REF  2  LAST  754      26,2000                    SETLOC P80S2
 0624                          26,2650                    BANK

 0625   REF  1                                            COUNT* $$/S61.2

A0626                                                                    PDL LEFT AT ZERO BY TARGETING

 0627                          26,2650  45345 1  S61.2    DLOAD  DSU
 06271  REF  1                26,2651  02020 1           EMSALT
 06272  REF  1                26,2652  15000 0           290KFT
 06273                         26,2653  71244 0           BPL    DLOAD
 06274  REF  1                26,2654  54774 1           LUNENT
 0626   REF  1                26,2655  17345 0           1/RTMU      ESTABLISH MU FOR ORBITAL ENTRIES
 06281                         26,2656  77624 1  CALLCON  CALL
 0629   REF  1                26,2657  56750 0           TFFCONIC    FILL VAC AREA WITH CONIC PARAMETERS

 0630                          26,2660  45145 0           DLOAD  CALL
 0631   REF  1                26,2661  15020 1           RTRIAL
 0632   REF  2  LAST  514      26,2662  57060 0           CALCTFF     1 ST GUESS AT TERMINAL RADIUS (-29)
                                                                      SAVES MPAC IN RTERM (18D)
 0633                          26,2663  77624 1           CALL
 0634   REF  2  LAST  634      26,2664  56573 0           TFF/TRIG    CALC SDELP/2, CDELP/2
                                                                      RETURN WITH S(THETA) IN MPAC
 0635                          26,2665  77624 1           CALL
 0636   REF  1                26,2666  55027 1           FISHCALC    GET FISCHER RADIUS (-29) M
                                                                      ANS IN MPAC AND IN ERADM.
 0637                          26,2667  45015 1           DAD    CALL
 0638   REF  2  LAST  762      26,2670  02020 1           EMSALT
 0639   REF  3  LAST  762      26,2671  57060 0           CALCTFF     SAVES MPAC IN RTERM (18D)

 0640                          26,2672  77676 0           DCOMP       NEGATIVE AS IN COUNTDOWN.
 0641   REF  3  LAST  745      26,2673  03733 0           STORE  TIE1 DECR TIE FROM BASE TIE1. (RESTART)
A0642                                                                 DNLIST AND DSKY WILL USE TIE.
 0643   REF  6  LAST  745      26,2674  37727 1           STCALL TIE  LET MISS CONTRL DECR BY ELAPSED TIME
A0644                                                                 TIE= TIME FROM NOW TO EMSALT +FISCHER

 0645   REF  3  LAST  762      26,2675  56573 0           TFF/TRIG    S(THETA) IN MPAC ON RETURNING
A0646                                                                 AND THETA= RANGE FROM NOW TO EMSALT
 0647                          26,2676  77624 1           CALL
 0648   REF  2  LAST  762      26,2677  55027 1           FISHCALC
 0649                          26,2700  77624 1           CALL
 0650   REF  1                26,2701  56626 0           VRCALC
 0651                          26,2702  77624 1           CALL
 06511  REF  1                26,2703  56613 0           DISPTARG
 06512                         26,2704  77624 1           CALL
 06513  REF  2  LAST  762      26,2705  56613 0           DISPTARG
 06514  REF  5  LAST  275      26,2706  37714 1           STCALL RTGO
```

```
 0652  REP  2  LAST  634   26,2707   55050 1          VGAMCALC

 0653                      26,2710   77605 1    DMP                MPAC = GAMMA
A0654                                                               PDL0 HAS VGAM.
 0655                      26,2711   43265 1    BDDV   DAD
 0656  REP  1              26,2712   15026 1           VEMSCON       -HS D 180/PI (-14)
 0657                      26,2713   00001 0           0             VGAM FROM PDL0.
 0658  REP  5  LAST  275   26,2714   17725 1    STODL  VIO           PREDICTED VELOCITY AT EMSALT.

A0659                                                       GAMMA AND VGAM AT 300K FT ARE REQUIRED BY  GMAX
A0660                                                       ALGORITHM.

 0661  REP  5  LAST  600   26,2715   02241 1           ERADM         EARTH RADIUS FROM GETERAD     (-29) M
A0662                                                               = FISCHER RADIUS  (-29)
 0663                      26,2716   77615 0    DAD
 0664  REP  1              26,2717   08462 1           300KFT        M  (-29)
 0665  REP  1              26,2720   34023 1    STCALL RTERM         TERMINAL RADIUS  M  (-29)

 0666  REP  1              26,2721   55045 0           PREVGAM       VGAMCALC WITH NEW RTERM

A0667                                                               VBAR = (V(FPS)  - 36KF/S) / 20KF/S
R0668    GMAX = (4/(1+ 4.8 VBARSQ))(GAM -6.05 -2.4 VBARSQ) -10(L/D -.3) +10    ASSUME L/D = 0.3, BANK =0.
A0670                                    GMAXCALC
 0671                      26,2722   45325 1    PDDL   DSU           GAM TO PDL2
 0672                      26,2723   00001 0           0             VGAM IS IN PDL0  (-7)
 0673  REP  1              26,2724   15004 1           36KFT/S       (-7)  M/CS
 0674                      26,2725   63471 0    DDV    DSQ
 0675  REP  1              26,2728   15008 0           20KFT/S       (-8)  M/CS
 0676                      26,2727   00001 0    STORE  0             VBARSQ  (-2)  TO PDL0

 0677                      26,2730   43205 1    DMP    DAD
 0678  REP  1              26,2731   15010 1           KR1
A0679                                                               GAM,    POS DOWN, FROM PDL2
 0680                      26,2732   41215 1    DAD    DMP
 0681  REP  1              26,2733   15012 0           -6.05DEG
 0682  REP  1              26,2734   15014 0           KR2
 0683                      26,2735   77725 1    PDDL                XCH PDL+0 FOR VBARSQ  (-2)
 0684                      26,2738   43271 1    DDV    DAD
 0685  REP  1              26,2737   15024 0           KR4
 0686  REP  1              26,2740   17357 0           DP2(-4)
 0687                      26,2741   77885 1    BDDV
A0688                                                               NUM FROM PDL+0
 0689                      26,2742   51015 1    DAD    BPL
 0690  REP  1              26,2743   15016 1           KR3
 0691                      26,2744   54747 1           +3
 0692                      26,2745   77745 1    DLOAD
 0693  REP 22  LAST  678   26,2748   15332 1           HI6ZEROS
 0694  REP  3  LAST  275   26,2747   17722 0    STODL  GMAX          100 GMAX  (-14)
```

R0695 DISPLAY USES GMAX AS SP, SO LO WORD IS WRITTEN OVER BY VPRED.

```
 0696  REF  6  LAST  763   26,2750  02241 1                 ERADM      = FISCHER RADIUS  (-29) M
 0697                      26,2751  45015 1          DAD    CALL       2 ND  ITERATION FOR FISCHER RADIUS
 0698  REF  1              26,2752  15022 0                 400KFT
 0699  REF  4  LAST  762   26,2753  57060 0                 CALCTPF    ESTABLISH TRANSFER ANGLE DATA.
 0700                      26,2754  77624 1          CALL
 0701  REF  4  LAST  762   26,2755  56573 0                 TPF/TRIG   GET SIN, COS DELF
 0702                      26,2756  77624 1          CALL
 0703  REF  3  LAST  762   26,2757  55027 1                 FISHCALC   GET CORRESPONDING FISCHER RADIUS.

 0704                      26,2760  73015 1          DAD    LXA,2      SAVE HI-WORD FOR DOWNLIST.
 0705  REF  2  LAST  764   26,2761  15022 0                 400KFT     M  (-29)
 0706  REF  6  LAST  762   26,2762  03713 1                 RTGO       (RANGE ANGLE FROM EMSALT)/360
 0707  REF  2  LAST  763   26,2763  34023 1          STCALL RTERM
 0706  REF  2  LAST  763   26,2764  55045 0                 PREVGAM    VGAMCALC WITH NEW RTERM

 0709                      26,2765  67076 1          DCOMP  SXA,2      HI-WORD OF EACH ON DOWNLIST.
 0710  REF 276  LAST  756   26,2766  00155 0                 MPAC  +1
 0711  REF  5  LAST  275   26,2767  17771 0          STODL  GAMMAEI     CONIC GAMMA/360 AT 400K FT.   ( HI-WORD)
A0712                                                                   CONIC RTGO/360 FROM EMSALT    (LOW-WORD)
A0713                                                                   FOR TM, DP(GAMMAEI)= (GAMMA, RTGO)/360

A0714                                                                   VGAM FROM PDL+0   (-7)
 0715                      26,2770  77626 0          STADR
 0716  REF  6  LAST  275   26,2771  74010 0          STORE  VPRED       CONIC VELOCITY AT 400K FT

 0717                      26,2772  77634 0          RTB
 0716  REF  1              26,2773  54267 0                 P61.1
A0719                                                                   PDL BACK TO ZERO.

 07192                     26,2774  52145 0  LUNENT  DLOAD  GOTO
 07193 REF  3  LAST  510   26,2775  06456 0                 1/RTMUE    ESTABLISH MU FOR LUNAR TYPE ENTRIES
 07194 REF  1              26,2776  54656 0                 CALLCON
 07195                     26,2777  00002 0  290KFT  2DEC   86392.0 B-29
 07195                     26,3000  26244 1
 07196                     26,3001  00052 0  KTETA1  2DEC*  .421844723 E2 B-14*      1100 2PI/16384(163.64)
 07196                     26,3002  05716 1
 0720                      26,3003  33335 1  36KFT/S 2DEC   109.728 B-7     (-7) M/CS = 36 KFT/S (-7)
 0720                      26,3004  05707 1
 0721                      26,3005  36365 1  20KFT/S 2DEC   121.92 B-7      (-6) M/CS  = 2 20KFT/S  (-7)
 0721                      26,3006  30244 0
 0722                      26,3007  77113 1  KR1     2DEC   -.026666667     =- 2.4  4 / 360
 0722                      26,3010  42770 1
 0723                      26,3011  77354 0  -6.05DEG 2DEC  -.016805556     = -6.05 / 360
 0723                      26,3012  65030 1
 0724                      26,3013  21450 0  KR2     2DEC   .54931641       =(360/4) 100 (-14) =  9000 B-14
 0724                      26,3014  00001 0
 0725                      26,3015  01750 1  KR3     2DEC   1000  B-14      = 100  (10.0)  (-14)  G,S
 0725                      26,3016  00000 1
```

L P61-P67 USER'S PAGE NO. 23 E6 S3

```
A0726                                                          ASSUMES L/D = 0.3, BANK =0.
 0727                    26,3017  00305 1  RTRIAL   2DEC   6460097.16 B-29  RPAD +284643 FT =21 194 545 FT
 0727                    26,3020  04541 0
A0726                                                  RPAD DEFINED AS 20 909 901.57 FT =6 373 338 M
 0729                    26,3021  00003 1  400KFT   2DEC   121920 B-29      METERS
 0729                    26,3022  27040 0

R0730  300KFT  2DEC  91440 B-29      (-29)  M

R0731  EMSALT  2DEC  86759.2 B-29    284643 FT (-29) M    (ORBITAL REENTRY)

R0732  EMSALT  2DEC  90657 B-29      297431 FT (-29) M    (LUNAR REENTRY)

 0733                    26,3023  32525 1  KR4      2DEC   .833333333
 0733                    26,3024  12525 0
 0734  REF  3  LAST  510 23,2461             300KFT   EQUALS MINPER8
 0735                    26,3025  77777 0  VEMSCON  2DEC   -.0389676 B-14   = -HS D  /2  PI  (-14)    M SQ/ CS SQ
 0735                    26,3026  76601 1
A0736                                                          =- 16389   .05G  32.2  .3048  .3046/2 PI    (-14)
```

```
P0737  SUBROUTINE NAME'  FISHCALC              (USED BY  S61.2)          DATE'          01.21.67
R0739  MOD NO'  0                                                        LOG SECTION"   P61-P67
R0741  MOD BY'  MORTH / BAIRNSFATHER
R0742  MOD NO'  1          MOD BY'  RR BAIRNSFATHER     DATE'  11 MAY 67     INCLUDE GETERAD CALL
R0744  FUNCTIONAL DESCRIPTION'  GIVEN THE PRESENT POSITION, UNITR, CALCULATE A  NEW UNITR THAT IS ROTATED THROUGH
R0746          TRANSFER ANGLE, THETA, ALONG TRAJECTORY. THEN CALCULATE  SIN(LAT)  AND USE TO OBTAIN FISCHER RADIUS.

R0748          SINCE FISHCALC USES UNI (LEFT BY ENTRY) EARTH SCALING IS ASSUMED.(WILL IMPROVE FOR SUITABLE TENNANT)

R0750  CALLING SEQUENCE'  CALL
R0751                        FISHCALC
R0752          ENTER WITH .5 SIN(THETA) IN MPAC.
R0753          PUSHLOC IS AT PDL+0, AN ARBITRARY BASE VALUE IF LEQ 8D

R0754  SUBROUTINES CALLED'  GETERAD
R0755  NORMAL EXIT MODE'    RVQ
R0756  EXIT MODES'           NONE
R0757  OUTPUT'  ERADM  (-29) M    IN MPAC ON RETURNING
R0758          NEW UNIT VECTOR NOT SAVED.
R0759          SIN(LAT) NOT SAVED.
R0760          PUSHLOC AT PDL+0
R0761  ERASABLE INITIALIZATION REQUIRED'
R0762          SDELF/2     =SIN(THETA)  /2,    IN MPAC                  LEFT BY TPIF/TRIG
R0764          CDELF/2     =COS(THETA) /2, STORED IN PDL 14D            LEFT BY TPIF/TRIG
R0766          RONE   (-29) M                                           LEFT BY [illegible]
R0766          VONE   (-7)  M/CS                                        LEFT BY [illegible]
R0770          URONE  UR/2                                              LEFT BY [illegible]
R0772          UNI          .5 UNIT( V*R)                               LEFT BY ENTRY / P61
R0774          UNITW        UNIT NORTH POLE                             LEFT BY PAD LOAD
R0776  DEBRIS'  QPRET,    PDL+0 ... PDL+5
R0777

A0776
 0779                        26,3027   47315 0  FISHCALC PDVL   VXV      URPR = (UR CDELF + UHOR SDELF
 0780  REF   3  LAST  744   26,3030   02343 1                   URONE
 0781  REF   3  LAST  744   26,3031   03502 0                   UNI
 0782                        26,3032   76561 1           VXSC    VSL1
A0783
 0784                        26,3033   74315 0           PDVL    VXSC     SIN(THETA)) //2 FROM PDL+0
 0785  REF   4  LAST  766   26,3034   02343 1                   URONE    TO PDL+3,,  +5
 0786  REF   2  LAST  634   26,3035   00017 1                   CDELF/2  COS(THETA)) //2
 0787                        26,3036   45455 1           VAD     STADR
 07671 REF   1               26,3037   74235 0           STORE   URH      FOR USE IN RTCG FROM EMS DISPLAY
 0788                        26,3040   72441 0           DOT     SL1
 0789  REF   7  LAST  529   26,3041   01714 1                   UNITW    FULL UNIT VECTOR     UNIT NORTH
 0790  REF  12  LAST  756   26,3042   02156 1           STORE   ALPHAV +4  = .5 SIN(LAT))
 0791                        26,3043   77650 1  DUMPFISH GOTO
 0792  REF   2  LAST  616   26,3044   26437 0                   GETERAD  SAVES FISCHER RAD (-29) M IN ERADM AND
A0793                                                                    IN MPAC.  RETURNS TO CALLER VIQ QPRET.
```

```
P0794   SUBROUTINE NAME'   VGAMCALC              (USED BY  S61.2)              DATE'          01.21.67
R0795   MOD NO'    0                                                          LOG SECTION'   P61-P67
R0796   MOD BY'  MORTH / BAIRNSFATHER
R0799   MOD NO'  1          MOD BY'  RR BAIRNSFATHER      DATE'  11 APR 67
R0800   MOD NO'  2          MOD BY'  RR BAIRNSFATHER      DATE'  21 NOV 67    VARIABLE MU ADDED.
R0802   MOD NO'  3          MOD BY'  RR BAIRNSFATHER      DATE'  21 MAR  68   ACCEPT DIFFERENT EARTH/MOON SCALE
R0804   FUNCTIONAL DESCRIPTION'      EARTH CENTERED VIS VIVA CALCULATION OF TERMINAL VELOCITY AND GAMMA (REL TO
R0808           HORIZONTAL)  GIVEN  THE SCALAR QUANTITIES'   PRESENT RADIUS AND VELOCITY AND THE TERMINAL RADIUS.
R0808           THE USER MUST APPEND PROPER SIGN TO GAMMA, SINCE IT IS CALCULATED AS A POSITIVE NUMBER.
R0810           THE EQUATIONS ARE

R0811                   VGAM = SQRT(VN VN/MU + 2(RN-RTERM)/(RN RTERM)  )  RTMU

R0812                   COSGAM = H /RTERM VGAM  = SQRT(LCP)/ (RTERM VGAM/RTMU)
R0813           VGAMCALC ASSUMES THAT THE TERMINAL RADIUS IS LESS THAN THE PRESENT RADIUS. BOTH CALCTFF AND CALCTPER
R0815           MAKE THIS ASSUMPTION.

R0816   CALLING SEQUENCE'  CALL                          STCALL RTERM
R0817                        VGAMCALC                      PREVGAM
R0818           PUSHLOC AT PDL+0, ARBITRARY  IF LEQ 12D
R0819           C(MPAC) UNSPECIFIED                  C(MPAC)=NEW RTERM

R0820   SUBROUTINES CALLED'  NONE
R0821   NORMAL EXIT MODE'    RVQ
R0822   ALARMS'    NONE
R0823   OUTPUT'    GAMMA / 360 IN MPAC, POSITIVE NUMBER
R0824             VGAM E'(-7)  M'(-5)   M/CS  IN PDL+0
R0825             PUSHLOC AT PDL+2
R0826   ERASABLE INITIALIZATION REQD'
R0827           TFF/RTMU E'(17) M'(14)   1/SQRT(MU)                          LEFT BY TFFCONIC.
R0829           RMAG1  E'(-29) M'(-27)   M   PRESENT RADIUS LENGTH          LEFT BY TFFCONIC
R0831           NRMAG  E' (-29+NR)       M  NORM LENGTH OF PRESENT POSITION  LEFT BY TFFCONIC
R0833                  M' (-27+NR)
R0834           RTERM  E'(-29) M'(-27)   M  TERMINAL RADIUS LENGTH           LEFT BY CALCTFF
R0836           NRTERM E' (-29+NR)       M  NORM LENGTH OF TERMINAL RADIUS   LEFT BY CALCTFF
R0838                  M' (-27+NR)
R0839           TFFVSQ E'(20)  M'(18)  1/M   -(V SQ/MU)' PRESENT VELOCITY,NORM LEFT BY TFFCONIC
R0841           TFFNP  E' (-38+2NR)      M  LCP, SEMI-LATUS RECTUM, WEIGHT NR  LEFT BY TFFCONIC
R0843                  M' (-38+2NR)
R0844   DEBRIS'  QPRET,   PDL+0 ... PDL+3
R0845           RTERM,  NRTERM  IF PREVGAM ENTERED.
```

```
P0846
 0847                          26,3045   77657 0  PREVGAM  SL*
A0848
 0849
 0850   REP   1                26,3046   20201 0                   0,1
                               26,3047   00021 1           STORE   NRTERM
 0851
                               26,3050   41345 0  VGAMCALC DLOAD   DMP
 0852   REP   1                26,3051   00041 1                   NRMAG
 0853   REP   2  LAST  788     26,3052   00021 1                   NRTERM
 0854                          26,3053   45325 1           PDDL    DSU
 0855   REP   2  LAST  788     26,3054   00041 1                   NRMAG
 0856   REP   3  LAST  788     26,3055   00021 1                   NRTERM
 0857                          26,3056   56257 1           SL*     DDV
 0858                          26,3057   20171 1                   0 -8D,1
A0859
 0860                          26,3080   77825 0           DSU
 0861   REP   1                26,3081   00025 0                   TPPVSQ
 0862                          26,3082   41588 1           SQRT    PUSH
 0863                          26,3083   65271 0           DDV     PDDL
A0864
 0865   REP   4  LAST  510     26,3084   00037 0                   TPP/RTMU
 0866                          26,3085   85205 0           DMP     PDDL
 0867   REP   4  LAST  788     26,3088   00021 1                   NRTERM
 0868   REP   1                26,3087   00035 1                   TPPNP
 0869                          26,3070   58388 1           SQRT    DDV
A0870
A08701
 0871                          26,3071   85542 1           SR1     ACOS
 0872                          26,3072   77818 0  DUMPVGAM RVQ

A08721

A0873
```

ENTER WITH NEW RTERM IN MPAC
E' (-29) M' (-27)
X1 = -NR
RTERM M E'(-29+NR) M'(-27+NR)

RMAG M E'(-29+NR) M'(-27+NR)
RTERM M E'(-29+NR) M'(-27+NR)
RMAG RTERM M E'(-58+2NR) M'(-54+2NR)
RMAG M E'(-29+NR) M'(-27+NR)
RTERM M E'(-29+NR) M'(-27+NR)
2(RN-RTERM) E'(-30+NR) M'(-28+NR)
(-8+NR)
PUSH UP PRODUCT.

-(V SQ/MU) E' (20) M' (18)
SAVE VGAM/RT(MU) FOR NOW. E'(10) M'(9)
XCH PDL+0, LEAVING VGAM FOR OUTPUT.
VGAM TO PDL M/CS E' (-7) M' (-2)
E' (17) M' (14)
RTERM VGAM/RTMU E'(-19+NR) M'(-18+NR)
RTERM M E'(-29+NR) M'(-27+NR)
LC P =H.H/MU M E'(-38+2NR) M'(-36+2NR)
E'(-19+NR) M'(-18+NR)
PUSH UP DEN E'(-19+NR) M'(-18+NR)
USE DDV OVFL AS LIMITER (VCOSY ±1.0)

CALLER MUST SUPPLY OWN SIGN ...

22W 27MS

```
P0874  SUBROUTINE NAME'     TPP/TRIG          (USED BY  S61.2)          DATE     01.17.67
R0876  MOD NO'  0                                                       LOG SECTION'    P61-P67
R0878  MOD BY'  RR BAIRNSPATHER
R0879  MOD NO'  1           MOD BY'  RR BAIRNSPATHER      DATE'  14 APR 67
R0880  MOD NO'  2           MOD BY'  RR BAIRNSPATHER      DATE'  21 MAR  88    ACCEPT DIFFERENT EARTH/MOON SCALE
R0882  FUNCTIONAL DESCRIPTION'      USED BY ENTRY DISPLAY TO CALCULATE SIN(THETA), COS(THETA) FROM DATA LEFT IN
R0884          PDL BY TPP SUBROUTINES. THE EQNS ARE
R0885                COS(THETA) = 1-2 ABS(ARG) /(RN RTERM (1+X)  )
                                                  2
R0887                SIN(THETA) = SGN(ARG) SQRT(1-COS (THETA) )
R0888          WHERE  THETA = TRANSFER ANGLE
R0889          AND    ARG = P Z ABS(Z)                                  IF ALFA ZZ   LEQ 1
R0891                ARG = (P / ALFA)  SGN(Q1 + R 1/Z)                  IF ALFA Z Z   G  1
R0893          AND  ARG  HAS BEEN AFFIXED WITH THE SIGN OF SIN(THETA).
R0894  CALLING SEQUENCE'  CALL
R0895                     TPP/TRIG
R0896          PUSHLOC AT PDL+0, ARBITRARY IF NOT EQ 14D
R0897          C(MPAC) UNSPECIFIED

R0898  SUBROUTINES CALLED'  NONE
R0899  NORMAL EXIT MODES'   RVQ
R0900  ALARMS'  NONE
R0901  OUTPUT'  C(MPAC) = .5 SIN(THETA)
R0902          CDELP/2 = .5 COS(THETA)          (IN PDL 14D)
R0903          PUSHLOC AT PDL+0
R0904  ERASABLE INITIALIZATION REQUIRED'
R0905          TPPX              X                                       LEFT BY CALCTPP OR CALCTPER
R0907          TPPTEM E' (-59+2NR)   ARG                                 LEFT BY CALCTPP OR CALCTPER
R0909                 M' (-55+2NR)   WHERE ARG = LCP ZZ SGN(DELP) OR ARG = LCP/ALFA  SGN(DELP)
R0911          NRTERM E' (-29+NR)      M  NORM LENGTH OF TERMINAL RADIUS  LEFT BY CALCTPP OR CALCTPER
R0913                 M' (-27+NR)
R0914          NRMAG  E' (-29+NR)      M  NORM LENGTH OF PRESENT POSITION LEFT BY TPPCONIC
R0916                 M' (-27+NR)
R0917  DEBRIS'  OPREST, CDELP/2
```

```
 09172                          27,2573                    BANK   27
 09173  REF   1                 27,2000                    SETLOC P60S5
 09175                          27,2573                    BANK
 0918                           27,2573   70545 1  TPP/TRIG DLOAD  SR1
 0919   REF   1                 27,2574   00043 0           TPPX
 0920                           27,2575   41215 1           DAD    DMP
 0921   REF   8  LAST  635      27,2576   15330 0           HIDPHALF
 0922   REF   3  LAST  768      27,2577   00041 1           NRMAG        RMAG  M          E'(-29+NR)  M'(-27+NR)
 0923                           27,2600   55205 0           DMP    BDDV
 0924   REF   5  LAST  768      27,2601   00021 1           NRTERM       RTERM M          E'(-29+NR)  M'(-27+NR)
 0925   REF   1                 27,2602   00045 0           TPPTEM       P ZSQ OR P/ALFA  E'(-59+2NR) M'(-55+2NR)
 0926                           27,2603   44246 1           ABS    BDSU  THE SIGN IS FOR SDELP.
 0927   REF   9  LAST  769      27,2604   15330 0           HIDPHALF
 0928   REF   3  LAST  766      27,2605   00017 1           STORE  CDELP/2    .5 COS(THETA)
 0929                           27,2606   57516 1           DSQ    DCOMP      KEEP HONEST FOR SORT.
```

L P61-P67

```
 0930                          27,2607  75415 0            DAD     SQRT
 0931  REF   1                 27,2610  15322 0                    HIDP1/4
 0932                          27,2611  43565 0  DUMPTRIG  SIGN    RVQ
 0933  REF   2  LAST  769      27,2612  00045 0                    TPPTEM
A0934

A0935

 0936                          27,2613  77620 0  DISPTARG  STQ
 0937  REF   4  LAST  759      27,2614  03373 0                    60GENRET
 0939                          27,2615  45205 1            DMP     DSU
 0940  REF   1                 27,2616  15002 1                    KTETA1
 0944  REF   4  LAST  762      27,2617  03733 0                    TTE1
 0945  REF   6  LAST  269      27,2620  37606 0            STCALL  DTEAROT
 0946  REF   2  LAST  269      27,2621  46225 0                    EARROT2
 0947                          27,2622  77624 1            CALL
 0948  REF   2  LAST  762      27,2623  56626 0                    VRCALC
 0949                          27,2624  77650 1            GOTO
 0950  REF   5  LAST  770      27,2625  03373 0                    60GENRET
 0951                          27,2626  50375 0  VRCALC    VLOAD   DOT
 0952  REF   2  LAST  766      27,2627  03542 1                    URH
 0953  REF   3  LAST  269      27,2630  03474 0                    RT
 0954                          27,2631  65512 1            SL2     ACOS
 0956                          27,2632  77616 0            RVQ
R0957  END OF PROGRAM  S61.2
```

APPIX SIGN(DELE/2)
RETURN WITH .5 SIN(THETA) IN MPAC

16W 15 MS

C(MPAC) = TRGO ESTIMATE

```
P0958
R0959   PROGRAM DESCRIPTION S62.3       DATE 10JAN67
R0960   MOD NO 1        LOG SECTION P60-P67
R0961   MOD BY ZELDIN
R0962   MOD NO' 2          MOD BY' RR BAIRNSFATHER     DATE' 15 MAY 67     CHANGED TO REF COORDS.
R0964   MOD NO' 3          MOD BY' RR BAIRNSFATHER     DATE' 17 JAN 68     ALFAPAD CHANGES MADE.
R0966   FUNCTIONAL DESCRIPTION
R0967           COMPUTE  DESIRED GIMBOL ANGLES FOR ENTRY ATTITUDE
R0968           THE FOLLOWING TRAJECTORY.TRIAD IS AVAILABLE IN MEMORY AND IS COMPUTED EACH 2 SECONDS BY  CM/POSE  IN
R0970           REFERENCE COORDINATES (V = VELOCITY RELATIVE TO EARTH) '

R0971                   UXA = -UNIT(V)
R0972                   UYA =  UNIT(V*R)
R0973                   UZA =  UXA*UYA

R0974           GENERATE A DESIRED BODY TRIAD FOR TRIMMED FLIGHT WITH RESPECT TO THE RELATIVE VELOCITY VECTOR, USING
R0976           ROLL COMMAND AND TRIM ANGLE OF ATTACK'

R0977                   UXD = UNIT(UYD*UXA) SIN(ALFATRIM) + UXA COS(ALFATRIM)
R0978                   UYD = UYA COS(ROLLC) + UZA SIN(ROLLC)
R0979                   UZD = UXD * UYD

R0980           USE THE DESIRED SET (IN REFERENCE COORDS) AND  REFSMMAT  TO CALL   CALCGA   AND OBTAIN GIMBAL ANGLES
R0982           IN 2S,C IN MPAC, +2 AND THETAD, +2.

R0983   CALLING SEQUENCE
R0984         L   CALL
R0985       L+1         S62.3
R0986   NORMAL EXIT MODE
R0987           RETURN VIA QPRET DIRECTLY FROM CALCGA.
R0988   SUBROUTINES CALLED
R0989           CALCGA
R0990   ALARM OR ABORT MODES
R0991           NONE
R0992   ERASABLE INITIALIZATION REQUIRED
R0993           ROLLC  ROLL COMMAND                    DP 1'S COMP AT 1REV
R0994           ALFAPAD   SP 1S,C     /180               LEFT BY PAD LOAD    ALFATRIM IS NEGATIVE.
R0996           UXA/2  REF COORDS                      LEFT BY CM/POSE
R0997           UYA/2  REF COORDS                      LEFT BY CM/POSE
R0998           UZA/2  REF COORDS                      LEFT BY CM/POSE
R0999   OUTPUT
R1000           CPHI   GIMBAL ANGLES (O,I,M) 2'S COMP TP (O,I,M)/180
R1001   DEBRIS
R1002         QTEMP, QPRET,PUSHLIST
R1003

 1004                        10,2302                 BANK   10
 1005   REF  1               10,2000                 SETLOC P60S4
 1006                        10,2302                 BANK
```

```
 1007   REF  1                                          COUNT* $$/S62.3

 1008                          10,2302  67201 0  S62.3  SETPD  SLOAD
 1009                          10,2303  00001 0         0
 1010   REF  2  LAST  747      10,2304  03012 1         ALPAPAD     ALPATRIM /180 , ALPA IS NEG.
 1011                          10,2305  41542 1         SR1    PUSH
 1012                          10,2306  65346 0         COS    PDDL        XCH PDL, COS TO PDL0
 1013                          10,2307  65356 1         SIN    PDDL        SIN TO PDL2
 1014   REF  7  LAST  747      10,2310  03316 0         ROLLC
 1015                          10,2311  74346 0         COS    VXSC
 1016   REF  2  LAST  116      10,2312  03550 1         UYA/2                          REF COORDS
 1017                          10,2313  73525 1         PDDL   SIN         PUSH VECTOR INTO PDL4,.9
 1018   REF  8  LAST  772      10,2314  03316 0         ROLLC
 1019                          10,2315  53361 0         VXSC   VAD
 1020   REF  2  LAST  116      10,2316  03556 1         UZA/2                          REF COORDS
A1021                                                                  VECTOR FROM PDL4, 9
 1022                          10,2317  77772 0         VSL1
 1023   REF  5  LAST  718      10,2320  02722 1         STORE  YNB         = UYD       REF COORDS

 1024                          10,2321  76435 1         VXV    VSL1
 1025   REF  3  LAST  116      10,2322  03542 1         UXA/2                          REF COORDS
 1026                          10,2323  65361 0         VXSC   PDDL
A1027                                                                  SIN TRIM FROM PDL2
A1028                                                                  XCH PDL0 FOR COS TRIM
 1029                          10,2324  53361 0         VXSC   VAD
 1030   REF  4  LAST  772      10,2325  03542 1         UXA/2                          REF COORDS
A1031                                                                  FROM PDL0
 1032                          10,2326  77772 0         VSL1
 1033   REF  9  LAST  726      10,2327  02714 1         STORE  XNB         X SC AXIS (.5 UNIT)     REF COORDS

 1034                          10,2330  76435 1         VXV    VSL1
 1035   REF  6  LAST  772      10,2331  02722 1         YNB
 1036   REF  6  LAST  716      10,2332  26730 1         STOVL  ZNB         Z SC IN REF COOR. SCALED AT 2
 1037   REF  29 LAST  756      10,2333  01736 1         REFSMMAT
 1038   REF  33 LAST  728      10,2334  26672 0         STOVL  XSM
 1039   REF  30 LAST  772      10,2335  01744 1         REFSMMAT +6
 1040   REF  4  LAST  436      10,2336  26700 1         STOVL  YSM
 1041   REF  31 LAST  772      10,2337  01752 0         REFSMMAT +12D
 1042   REF  3  LAST  436      10,2340  02706 1         STORE  ZSM

 1043                          10,2341  52014 0         CLEAR  GOTO
 1044   REF  1                 10,2342  00260 0         CPHIFLAG   CAUSE CALCGA TO STORE ANS IN TP CPHI
 1045   REF  3  LAST  726      10,2343  47244 0         CALCGA
A1046                                                                  CALCGA WILL RETURN TO ORIGINAL CALLER
A1047                                                                  VIA OPRET WITH 2,S COMP. ANGLES IN CPH1
```

L SERVICER207 USER'S PAGE NO. 1 E0 S3

```
R0001   PROGRAM NAME - PREREAD, READACCS, SERVICER, AVERAGE G.
R0002   MOD NO.  00   BY M.HAMILTON   DEC.12, 1966
R0003   FUNCTIONAL DESCRIPTION

R0004   THE ROUTINES DESCRIBED BELOW ARE USED TO CALCULATE VALUES OF RN, VN, AND GDT/2 DURING ACCELERATED FLIGHT.
R0006   THE SEVERAL ROUTINES COMPRISE A PACKAGE AND ARE NOT MEANT TO BE USED AS SEPARATE SUBROUTINES.

R0008   GENERAL REFERENCES TO  SERVICER  OR  AVERAGE G  ARE UNDERSTOOD TO REFER TO THE ENTIRE SET OF ROUTINES INCLUDING
R0010   READACCS, SERVICER, AVERAGE G, INTERead, SMOOTHER, AND ANY ADDITIONAL ROUTINES ATTACHED AT AVGEXIT (SEE BELOW).

R0012   PROGRAMS INITIATING SERVICER ARE REQUIRED TO MAKE A WAITLIST CALL FOR PREREAD (OR, IF LIFTOFF, FOR BIBIBIAS)
R0014   AT 2 SECONDS BEFORE THE FIRST AVERAGE G UPDATE IN ORDER TO INITIALIZE THE SEQUENCE, WHICH WILL RECUR EVERY
R0016   2 SECONDS FROM THAT TIME ON AS LONG AS AVEGFLAG REMAINS SET.

R0017   THE USE OF ERASABLE AVGEXIT ALLOWS VARIOUS ROUTINES TO BE PERFORMED AS PART OF THE NORMAL CYCLE (SEE
R0019   EXPLANATION OF AVGEXIT BELOW).

R0020   DESCRIPTIONS OF INDIVIDUAL ROUTINES FOLLOW.
R0021      PREREAD

R0022           PREVIOUSLY EXTRAPOLATED VALUES COPIED FROM RN1, VN1, AND PIPTIME1 INTO RN, VN, AND PIPTIME.
R0024           LASTBIAS JOB SCHEDULED.
R0025           PIPS READ AND CLEARED VIA PIPASR SUBROUTINE.
R0026           AVERAGE G FLAG SET ON.
R0027           DRIFT FLAG SET OFF.
R0028           V37 FLAG SET ON.
R0029           INITIALIZATION OF   1) THRUST MONITOR (DVMON) - DVCNTR SET TO ONE.
R0031                               2) TOTAL ACCUMULATED DELV VALUE (DVTOTAL) - SET TO ZERO.
R0033                               3) AXIS VECTOR (AXIS) - SET TO (.5,0,0).
R0034           NORMLIZE JOB SCHEDULED.
R0035           READACCS TASK CALLED IN 2 SECONDS.
R0036      NORMLIZE

R0037           GDT/2 INITIALIZED VIA CALCGRAV SUBROUTINE.
R0038      READACCS

R0039           IF ONMON FLAG SET QUIKREAD ROUTINE IS PERFORMED BEFORE PIPASR ZEROS THE PIPA REGISTERS, AND THE 1/2 SEC
R0041           ONMONITOR LOOP IS INITIATED TO PROVIDE DOWNLINK INFORMATION DURING ENTRY.
R0043           PIPS READ AND CLEARED BY PIPASR SUBROUTINE.
R0044           IF CM/DSTBY IS ON, ENTRY VARIABLES INITIALIZED AND SETJTAG TASK CALLED.
```

```
R0047           IF AVERAGEG FLAG ON    READACCS CALLED TO RECYCLE IN 2 SECONDS.
R0048           IF AVERAGEG FLAG OFF   AVERAGE G EXIT (AVGEXIT) SET TO 2CADR AVGEND FOR FINAL PASS.
R0050           SERVICER JOB SCHEDULED.
R0051           TEST CONNECTOR OUTBIT TURNED ON.
R0052   ONMNITOR

R0053           A SEQUENCE OF THREE PASSES THROUGH QUICKREAD FOLLOWING A CALL TO READACCS WITH ONMONFLG SET AT 1/2
R0055           SEC INTERVALS. INTERVALS ARE COUNTED OUT BY PIPCTR, INITIALISED AT 3 BY READACCS

R0057     QUIKREAD

R0058           READS CURRENT PIPS INTO X,Y,ZPIPBUF. READS OLD X,Y,ZPIPBUF INTO X,Y,ZOLDBUF. VALUES ARE SENT TO
R0060             DOWNLIST DURING ENTRY.
R0061     SERVICER
R0062           DELV VALUES CHECKED TO DETECT RUNAWAY PIP -
R0063                 IF BAD PIP   1) ALARM SENT.
R0064                              2) COMPENSATION, DVTOTAL ACCUMULATION, AND DVMON BYPASSED.  CONTROL
R0066                                 TRANSFERRED TO AVERAGE G.
R0067           PIPS COMPENSATED VIA 1/PIPA SUBROUTINE.
R0068           DVTOTAL INCREMENTED BY ABSOLUTE VALUE OF DELV.
R0069           THRUST MONITOR (DVMON) PERFORMED UNLESS IDLE FLAG IS ON.
R0070           CONTROL TRANSFERRED TO AVERAGE G.
R0071           DVMON

R0072             THRESHOLD VALUE (PLACED IN DVTHRUSH BY USER) CHECKED AGAINST ABSOLUTE VALUE OF DELV TO CHECK
R0074             THRUST LEVEL.
R0075                 IF THRUST    1) ULLAGE OFF ROUTINE PERFORMED.
R0076                              2) STEERING FLAG TURNED ON AT FIRST DETECTION OF THRUST.
R0078                              3) CONTROL TRANSFERRED TO AVERAGE G.
R0079                 IF NO THRUST 1) ON FIRST PASS THROUGH MONITOR, CONTROL TRANSFERRED TO AVERAGE G.
R0081                              2) ON SUBSEQUENT PASSES, CONTROL TRANSFERRED TO ENGINE FAIL ROUTINE IF THRUST
R0083                                 HAS FAILED FOR 3 CONSECUTIVE PASSES.
R0084           ENGINE FAIL

R0085             ENGFAIL1 TASK CALLED IN 2.5 SECONDS.  THIS WILL RETURN CONTROL TO TIG-5 SO THAT THE IGNITION
R0087                SEQUENCE MAY BE REPEATED.
R0088             ENGINOF3 PERFORMED.
R0089             DAP SET UP FOR RCS.
R0090     AVERAGE G
```

```
R0091          RN1, VN1, GDT1/2 CALCULATED VIA CALCRVG ROUTINE BY UPDATING RN, VN WITH DELV AND AN AVERAGED VALUE
R0093          OF GDT/2.
R0094          RN1, VN1, GDT1/2, PIPTIME1 COPIED INTO RN, VN, GDT/2, PIPTIME FOR RESTART PROTECTION.
R0096          CONTROL TRANSFERRED TO ADDRESS SPECIFIED BY USER (OR BY READACCS FOR LAST PASS) IN AVGEXIT.
R0098          LAST PASS (AVGEND)  1) FREE FALL GYRO COMPENSATION SET UP.
R0099                              2) DRIFT FLAG TURNED ON.
R0100                              3) STATE VECTOR TRANSFERRED VIA AVETOMID ROUTINE.
R0102                              4) ONMONITOR FLAG RESET.
R0103                              5) V37 FLAG RESET.
R0104                              6) TEST CONNECTOR OUTBIT RESET.
R0105                              7) CONTROL TRANSFERRED TO CANV37 TO CONTINUE MM CHANGE ROUTINE (ROO).
R0108  CALLING SEQUENCE

R0109          PREREAD ENTERED DIRECTLY FROM TIG-30 VIA POSTJUMP.
R0110          READACCS CALLED AS WAITLIST TASK.
R0112  SUBROUTINES CALLED

R0113          UTILITY ROUTINES - PHASCHNG FLAGUP FLAGDOWN NOVAC FINDVAC WAITLIST ALARM NEWPHASE 2PHSCHNG

R0115          OTHER - PIPASR  1/PIPA  CALCGRAV  CALCRVG  AVETOMID
R0116  NORMAL EXIT MODES

R0117          ENDOFJOB  TASKOVER  CANV37

R0116          AVGEXIT - THIS IS A DOUBLE PRECISION ERASABLE LOCATION BY WHICH CONTROL IS TRANSFERRED AT THE END
R0120                    OF EACH CYCLE OF AVERAGE G.
R0121                    THE 2CADR OF A ROUTINE TO BE PERFORMED AT THAT TIME (E.G., STEERING EQUATIONS TO BE PERFORMED
R0123                    AT 2 SECOND INTERVALS) MAY BE SET BY THE USER INTO AVGEXIT.
R0125                    ALL SUCH ROUTINES SHOULD RETURN TO SERVEXIT, WHICH IS THE NORMAL EXIT FROM AVERAGE G.

R0127          SERVEXIT - DOES A PHASE CHANGE FOR RESTART PROTECTION AND GOES TO ENDOFJOB.
R0129                    THE 2CADR OF SERVEXIT IS SET INTO AVGEXIT BY THE USER IF NO OTHER ROUTINE (SEE ABOVE).

R0131          AVGEND - LAST PASS OF AVERAGE G EXITS HERE, BYPASSING SPECIAL ROUTINE (SEE ABOVE UNDER READACCS).
R0133                   FINAL EXIT IS TO CANV37.                                F AVERAGE G).
R0135  OUTPUT

R0136     DVTOTAL(2)  PIPTIME(2)  XPIPBUF(2)  YPIPBUF(2)  ZPIPBUF(2)
R0137     RN(6)        REFERENCE COORD.   SCALED AT 2(+29)M/CS
R0138     VN(6)        REFERENCE COORD.   SCALED AT 2(+7)M/CS
R0139     GDT/2(6)     REFERENCE COORD.   SCALED AT 2(+7)M/CS
R0140     DELV(6)      STABLE MEMB. COORD.SCALED AT 2(+14)*5.85*10(-4)M/CS (KPIP1 USED TO GET DV/2 AT 2(+7))
```

L SERVICER207 USER-S PAGE NO. 4 E0 83

```
R0142     DELVREF(6)   REFERENCE COORD.   SCALED AT 2(+7)M/CS

R0143   INITIALIZATION

R0144           ONMONITOR FLAG SET BY ENTRY TO SHOW PIPBUF VALUES REQUIRED.
R0145           IDLE FLAG ON IF DVMON TO BE BYPASSED.
R0146           DVTHRUSH SET TO APPROPRIATE VALUE FOR DVMON.
R0147           AVGEXIT SET TO 2CADR OF ROUTINE, IF ANY, TO BE PERFORMED AFTER EACH CYCLE OF AVERAGE G.  IF NO ROUTINE
R0149                 TO BE DONE, AVGEXIT SET TO SERVEXIT.
R0150           VALUES NEEDED
R0151                 REFSMMAT
R0152                 UNITW - FULL UNIT VECTOR, IN REFERENCE COORD., OF EARTH S ROTATIONAL VECTOR
R0154                 RN1, VN1, PIPTIME1 - IN REFERENCE COORD., CONSISTENT WITH TIME OF EXECUTION OF PREREAD
R0156   DEBRIS

R0157     CENTRALS     A, L, Q
R0158     OTHER        INTERNAL - DVCNTR(1)  PIPAGE(1)  PIPCTR(1)  AVGEXIT(2)
R0159                  EXTERNAL - ITEMP1(1)  ITEMP2(1)  RUPTREG1(1)  TEMX(1)  TEMY(1)  TEMZ(1)
R0181                  USEFUL DEBRIS
R0182                     RN1(8)  VN1(8)  CDT1/2  PIPTIME1(2)
R0163                        THESE LOCATIONS USED AS BUFFER STORAGE FOR NEWLY CALCULATED VALUES OF RN, VN, CDT/2,
R0185                        AND PIPTIME DURING PERFORMANCE OF SERVICER ROUTINES.
R0187                     UNITR - HALF UNIT VECTOR OF RN, REFERENCE COORD.
R0188                     RMAG SCALED AT 2(+58) IN 38D.
R0189                     RMAGSQ SCALED AT 2(+58) IN 34D.
R0170                     (RE/RMAG)SQ IN 32D.
 0171                       27,2833                    BANK   27
 0172   REF  1              37,2000                    SETLOC SERVICES
 0173                       37,2604                    BANK

 0174   REF  13 LAST 759    E7,1431                    EBANK= DVCNTR
R0175   ********************************************  PREREAD  ************************************************************
R0177

 0178   REF  1                                         COUNT  37/SERV

 0185   REF  1              37,2804  3 4788 1  PREREAD  CAF    PRIO21          CALLER MUST PROTECT PREREAD
 0186   REF  26 LAST 752    37,2805  0 5027 1          TC     NOVAC
 0187   REF  6  LAST 299    E3,1480                    EBANK= NBDX
 0188   REF  1              37,2808   03838 1          2CADR  LASTBIAS        DO LAST GYRO COMPENSATION IN FREE FALL
 0188   REF  1              37,2807   14063 1

A01882                                                                      CALL-TO AND LASTBIAS ITSELF ARE NOT
A01883                                                                           PROTECTED. REREADAC SETS 1/PIPADT
A01884                                                                           TO 2.0 SECS IN CASE LASTBIAS LOST.
A01885                                                                           (REDUNDANT IF LASTBIAS IS AOK)
```

```
0189  REP   2  LAST  527   37,2610  0 2625 1  REDO5.31 TC    PREREAD1

0190  REP   4  LAST  225   37,2611  3 7667 1           CAF   PRIO32
0191  REP  28  LAST  756   37,2612  0 5042 1           TC    FINDVAC      SET UP NORMLIZE JOB REQUIRED PRIOR TO
0192  REP  14  LAST  776   E7,1431                     EBANK= DVCNTR      FIRST AVERAGE G PASS
0193  REP   3  LAST  530   37,2613   03141 0           2CADR NORMLIZE
0193                       37,2614   76067 1
0194  REP   3  LAST  642   37,2615  3 4735 1           CAF   2SECS
0195  REP  37  LAST  756   37,2616  0 5140 1           TC    WAITLIST
0196  REP  19  LAST  756   E6,1661                     EBANK= ACC
0197  REP   2  LAST  530   37,2617   02647 0           2CADR READACCS
0197                       37,2620   76066 0
0198  REP  33  LAST  563   37,2621  4 4711 0           CS    TWO
0199  REP   7  LAST  654   37,2622  0 4114 1           TC    NEWPHASE
0200                       37,2623   00005 1           OCT   5

0201  REP  41  LAST  748   37,2624  1 5213 0           TCF   TASKOVER
0202                       37,2625  0 0006 1  PREREAD1 EXTEND
0203  REP  17  LAST  217   37,2626  22 070 0           QXCH  RUPTREG1

0204  REP   1               37,2627  0 3157 1           TC    PIPASR       CLEAR + READ PIPS LAST TIME IN FREE FALL

02042 REP  94  LAST  749   37,2630  3 4712 1           CAF   ONE          SET UP PIPAGE FOR REREADAC IN CASE A
02043 REP   2  LAST   77   37,2631  55=230 0           TS    PIPAGE             RESTART OCCURS BEFORE READACCS

0205  REP  19  LAST  689   37,2632  4 0075 1           CS    FLAGWRD1     SET AVEG FLAG
0206  REP  58  LAST  724   37,2633  7 4712 0           MASK  BIT1
0207  REP  20  LAST  777   37,2634  26 075 1           ADS   FLAGWRD1

0208  REP  16  LAST  677   37,2635  3 4672 0           CA    POSMAX
0209  REP  14  LAST  657   37,2636  7 0076 1           MASK  FLAGWRD2
0210  REP  15  LAST  777   37,2637  54 076 1           TS    FLAGWRD2     KNOCK DOWN DRIFT FLAG

0211  REP  17  LAST  688   37,2640  4 0103 1           CS    FLAGWRD7     SET V37 FLAG
0212  REP  35  LAST  700   37,2641  7 4705 0           MASK  BIT6
0213  REP  18  LAST  777   37,2642  26 103 1           ADS   FLAGWRD7

0218  REP 149  LAST  738   37,2643  3 4714 1           CAF   ZERO
0224  REP   5  LAST  641   37,2644  55=425 1           TS    DVTOTAL      CLEAR DVTOTAL
0225  REP   6  LAST  777   37,2645  55=426 1           TS    DVTOTAL +1

0226  REP  18  LAST  777   37,2646  0 0070 0           TC    RUPTREG1
```

```
P0227  ************************************  READACCS  ************************************************************
 0229  REF  20  LAST  777   E6,1661                      EBANK= ACG
 0242  REF   2  LAST  777   37,2647   0 3157 1  READACCS TC     PIPASR

 0243  REF  17  LAST  724   37,2650   3 4715 0  PIPSDONE CAF    FIVE
 0244  REF  72  LAST  737   37,2651  54 001  1           TS     L
 0245                       37,2652   4 0000 0           COM
 0246  REF   3  LAST  526   37,2653  52 763  1           DXCH   -PHASE5

 0247  REF  95  LAST  777   37,2654   3 4712 1  REDO5.5  CAF    ONE          SHOW PIPS HAVE BEEN READ
 0248  REF   3  LAST  777   37,2655  55=230  0           TS     PIPAGE

 0249  REF  34  LAST  777   37,2656   3 4711 1           CA     TWO          SET PIPCTR FOR ONMINTOR
 0250  REF   2  LAST   77   37,2657  55=227  0           TS     PIPCTR       AFTER ABOVE PHASCHNG

 0251  REF   3  LAST  754   37,2660   4 0102 0           CS     CM/FLAGS
 0252  REF  33  LAST  695   37,2661   7 4711 0           MASK   BIT2         CM/DSTBY
 0253  REF 160  LAST  737   37,2662  10 000  0           CCS    A
 0254  REF   2  LAST  212   37,2663   0 2736 1           TC     CHECKAVEG

 0255  REF   6  LAST  642   37,2664   4 1246 1           CS     PIPTIME1 +1
 0256  REF   2  LAST  659   37,2665  55=065  1           TS     TBASE6       FOR RESTARTS
 0260                       37,2666   0 0006 1           EXTEND               CONTINUE FOR ENTRY DAP
 0261  REF  21  LAST  776   37,2667   3 1662 1           DCA    ACG
 0262  REF   2  LAST  109   37,2670  53=670  0           DXCH   ACG/PIP
 0263  REF   2  LAST  109   37,2671   3 1663 0           CA     AMG
 0264  REF   2  LAST  109   37,2672  57=671  0           XCH    AMG/PIP
 0265                       37,2673   0 0006 1           EXTEND
 0266  REF   2  LAST  109   37,2674   3 1665 0           DCA    ROLL/160
 0267  REF   2  LAST  109   37,2675  53=673  0           DXCH   ROLL/PIP
 0266  REF   2  LAST  109   37,2676   3 1666 0           CA     BETA/160
 0269  REF   2  LAST  109   37,2677  57=674  0           XCH    BETA/PIP
 0270  REF   4  LAST  776   37,2700   3 0102 1           CA     CM/FLAGS
 0271  REF  26  LAST  662   37,2701   7 4677 1           MASK   BIT12        CM/DAPARM  93D  BIT12
 0272                       37,2702   0 0006 1           EXTEND               DURING ENTRY, WHEN RCS DAP IS INACTIVE,
 0273  REF   1              37,2703   1 2721 0           BZF    NOSAVPIP      SAVE PIPAS EACH 0.5 SEC FOR TM.

 0274  REF   1              37,2704   3 2771 1           CA     0.5SEC
 0275  REF  36  LAST  777   37,2705   0 5140 1           TC     WAITLIST
 0276  REF   2  LAST  114   E6,1533                      EBANK= XPIPBUF
 0277  REF   1              37,2706   02772  1           2CADR  QUIKREAD
 0277  REF   1              37,2707   76066  0
A0276                                                                    NO NEED TO RESTART PROTECT THIS.
 0279  REF   9  LAST  431   37,2710   3 1162 0           CA     DELVX        SAVE PIPAS AS READ (BUT NOT COMPENSATED)
 0280  REF   3  LAST  776   37,2711  57=533  0           XCH    XPIPBUF
 0261  REF   2  LAST  114   37,2712  55=536  1           TS     XOLDBUF

 0262  REF   5  LAST  430   37,2713   3 1164 0           CA     DELVY
 0263  REF   2  LAST  114   37,2714  57=534  1           XCH    YPIPBUF
 0264  REF   2  LAST  114   37,2715  55=537  0           TS     YOLDBUF
```

```
0285  REF   4  LAST  430   37,2716  3 1166 1          CA    DELVZ
0286  REF   2  LAST  114   37,2717  57=535 0          XCH   ZPIPBUF
0287  REF   1              37,2720  55=540 0          TS    ZOLDBUF

0288  REF  18  LAST  778   37,2721  3 4715 0  NOSAVPIP CA    PIVE
0289  REF   4  LAST  213   37,2722  55=725 1          TS    CM/GYMDT

0290  REF   1              37,2723  3 3136 0          CA    JTAGTIME     ACTIVATE CM/RCS AFTER PIPUP TO GO
A0291                                                                   IN JTAGTIME +5 CS.
0292  REF  39  LAST  776   37,2724  0 5140 1          TC    WAITLIST
0293  REF  22  LAST  778   E6,1661                    EBANK= ACG
0294  REF   2  LAST  206   37,2725   03227 0          2CADR SETJTAG
0294                       37,2726   32066 0

0295  REF  26  LAST  754   37,2727  4 6214 1          CS    THREE        1.3SPOT FOR SETJTAG
0296  REF   8  LAST  777   37,2730  0 4114 1          TC    NEWPHASE
0297                       37,2731   00001 0          OCT   1

0298  REF   4  LAST  646   37,2732  3 4362 1          CAF   OCT37
0299  REF  73  LAST  778   37,2733  54 001 1          TS    L
0300                       37,2734  4 0000 0          COM
0301  REF   4  LAST  776   37,2735  52 763 1          DXCH  -PHASE5

0302  REF  21  LAST  777   37,2736  4 0075 1  CHEKAVEG CS    FLAGWRD1
0303  REF  59  LAST  777   37,2737  7 4712 0          MASK  BIT1
0304  REF 161  LAST  778   37,2740  10 000 0          CCS   A            IF AVEG FLAG DOWN SET FINAL EXIT AVEG
0305  REF   1              37,2741  0 2761 0          TC    AVEGOUT

0306  REF   4  LAST  777   37,2742  3 4735 1          CAF   2SECS
0307  REF  40  LAST  779   37,2743  0 5140 1          TC    WAITLIST
0308  REF  23  LAST  779   E6,1661                    EBANK= ACG
0309  REF   3  LAST  777   37,2744   02647 0          2CADR READACCS
0309                       37,2745   76066 0

0310  REF   7  LAST  665   37,2746  3 4675 1  MAKESERV CAF   PRIO20       ESTABLISH SERVICER ROUTINE
0311  REF  29  LAST  777   37,2747  0 5042 1          TC    FINDVAC
0312  REF  15  LAST  777   E7,1431                    EBANK= DVCNTR
0313  REF   2  LAST  211   37,2750   03007 0          2CADR SERVICER
0313                       37,2751   76067 1

0314  REF   6  LAST  429   37,2752  4 4710 1          CS    FOUR         RESTART SERVICER AND READACCS
0315  REF   9  LAST  779   37,2753  0 4114 1          TC    NEWPHASE
0316                       37,2754   00005 1          OCT   5

0317  REF  27  LAST  721   37,2755  3 4702 0          CAF   BIT9
0318                       37,2756  0 0006 1          EXTEND
0319  REF  25  LAST  657   37,2757  05 011 1          WOR   DSALMOUT     TURN TEST CONNECTOR OUTBIT ON

0320  REF  42  LAST  777   37,2760  1 5213 0          TCF   TASKOVER     END PREVIOUS READACCS WAITLIST TASK
```

```
0321
0322  REP   1                    37,2761  0 0006 1  AVEGOUT  EXTEND
0323  REP   2  LAST  529          37,2762  3 2766 1           DCA     AVOUTCAD
0324  REP   1                    37,2763  53=223 1           DXCH    AVGEXIT
                                 37,2764  1 2746 1           TCF     MAKESERV

0325  REP  16  LAST  779          E7,1431                     EBANK=  DVCNTR
0326  REP   1                    37,2765   03070 0  AVOUTCAD 2CADR   AVGEND
0326  REP   1                    37,2766   76067 1
```

```
P0327   ROUTINE NAME' ONMNITOR
R0328   MOD 04 BY BAIRNSFATHER  30 APR 1968                    REDO ONMNITOR TO SAVE PIPS EACH 0.5 SEC FOR TM,ENTRY.
R0330   MOD 03 BY FISHER DECEMBER 1967
R0331   MOD 02 BY RYE SEPT 1967
R0332   MOD 01 BY KOSMALA 23 MAR 1967
R0333   MOD 00 BY KOSMALA 27 FEB 1967

R0334   FUNCTIONAL DESCRIPTION

R0335           THE PURPOSE OF ONMONITOR IS TO PROVIDE 1/2 SEC.READING OF PIPAS FOR DOWNLIST DURING ENTRY.
R0337           X,Y,ZPIPBUF CONTAIN PRESENT VALUES X,Y,ZOLDBUF CONTAIN VALUES FROM PREVIOUS READING.

R0339   CALLING SEQUENCE

R0340           CALL AS WAITLIST TASK. TERMINATES ITSELF IN TASKOVER

R0341   INITIALISATION

R0342           PIPCTR = 2 (FOR DT = 0.5 SEC)
R0343           X,Y,ZPIPBUF SET TO PREVIOUS PIPAX,Y,Z

R0344   OUTPUT

R0345           X,Y,ZPIPBUF, X,Y,ZOLDBUF
R0346   DEBRIS

R0347           X,Y,ZPIPBUF CONTAIN LAST PIPAX,Y,Z VALUES
R0348                X,Y,ZOLDBUF CONTAIN LAST-BUT-ONE PIPAX,Y,Z VALUES
R0349           RUPTREG1
R0350           PIPCTR

 0351   REF   3  LAST  778   37,2767  55#227 0  ONMNITOR TS     PIPCTR

 0352   REF  12  LAST  687   37,2770  0 5156 0           TC     PIXDELAY        WAIT
 0353                        37,2771   00062 0  0.5SEC   DEC    50

 0354   REF  35  LAST  778   37,2772  3 4711 1  QUIKREAD CAF    TWO
 0355   REF  19  LAST  777   37,2773  54 070 1           TS     RUPTREG1
 0356   REF 182  LAST  779   37,2774  50 000 1           INDEX  A
 0357   REF   8  LAST  430   37,2775  3 0037 0           CA     PIPAX           SAVE ACTUAL PIPAS FOR TM.
 0358   REF  20  LAST  781   37,2776  50 070 0           INDEX  RUPTREG1
 0359   REF   4  LAST  778   37,2777  57#533 0           XCH    XPIPBUF         UPDATE X,Y,ZPIPBUF
 0360   REF  21  LAST  781   37,3000  50 070 0           INDEX  RUPTREG1
 0361   REF   3  LAST  778   37,3001  55#536 1           TS     XOLDBUF         AND X,Y,ZOLDBUF
 0362   REF  22  LAST  781   37,3002  10 070 1  CHKCTR    CCS    RUPTREG1
 0363   REF   2  LAST  778   37,3003  1 2773 1           TCF    QUIKREAD +1     LOOP AGAIN
 0364   REF   4  LAST  781   37,3004  11#227 0           CCS    PIPCTR
 0365   REF   1                37,3005  1 2767 1           TCF    ONMNITOR
 0366   REF  43  LAST  779   37,3006  0 5213 1           TC     TASKOVER
```

```
P0367  ************************************  SERVICER  ************************************************************
R0369

0370   REF  17  LAST  780   E7,1431                          EBANK= DVCNTR

0371   REF  36  LAST  781   37,3007  3 4711 1  SERVICER CAF    TWO
0372                        37,3010  0 0004 0          INHINT
0373   REF  23  LAST  781   37,3011  54 070 1  PIPCHECK TS     RUPTREG1

0374                        37,3012  6 0000 1          DOUBLE
0375   REF 183  LAST  781   37,3013  50 000 1          INDEX    A
0376   REF  10  LAST  778   37,3014  11=162 1          CCS      DELVX
0377                        37,3015  0 3017 1          TC       +2
0378   REF   1              37,3016  0 3025 0          TC       PIPLOOP

0379   REF   1              37,3017  6 3135 0          AD       -MAXDELV      DO PIPA-SATURATION TEST BEFORE
0380                        37,3020  0 0006 1          EXTEND
0381   REF   2  LAST  782   37,3021  6 3025 0          BZMP     PIPLOOP       COMPENSATION.

0382   REF  32  LAST  759   37,3022  0 5537 0          TC       ALARM
0383                        37,3023   00205 0          OCT      00205         SATURATED-PIPA ALARM  ***CHANGE LATER
0384   REF   1              37,3024  0 3046 0          TC       AVERAGEG

0385   REF  24  LAST  782   37,3025  10 070 1  PIPLOOP CCS      RUPTREG1
0386   REF   1              37,3026  1 3011 0          TCF      PIPCHECK

0387   REF  80  LAST  758   37,3027  0 5301 0          TC       PHASCHNG      RESTART REREADAC + SERVICER
0388                        37,3030   16035 0          OCT      16035
0389                        37,3031   20000 0          OCT      20000
0390   REF  16  LAST  782   E7,1431                          EBANK= DVCNTR
0391   REF   1              37,3032   03036 1          2CADR    DVTOTUP
0391   REF   1              37,3033   76067 1

0392   REF 232  LAST  759   37,3034  0 4555 0          TC       BANKCALL      PIPA COMPENSATION CALL
0393   REF   2  LAST  431   37,3035   15262 0          CADR     1/PIPA

0394   REF 200  LAST  758   37,3036  0 6006 1  DVTOTUP TC       INTPRET
0395                        37,3037   51575 1          VLOAD    ABVAL         GET ABS VALUE OF DELV
0396   REF   8  LAST  174   37,3040   01163 1                   DELV
0397                        37,3041   77405 0          DMP      EXIT
0398   REF   1              37,3042   37354 1                   KPIP1         SCALE AT 2(+7)

0399                        37,3043  0 0006 1          EXTEND
0400   REF 279  LAST  764   37,3044  3 0155 0          DCA      MPAC
0401   REF   7  LAST  777   37,3045  21=426 1          DAS      DVTOTAL       ACCUMULATE DVTOTAL
0402   REF  81  LAST  782   37,3046  0 5301 0  AVERAGEG TC      PHASCHNG
0403                        37,3047   10035 0          OCT      10035

0404   REF 201  LAST  782   37,3050  0 6006 1          TC       INTPRET
0405                        37,3051   77624 1          CALL
```

```
0406   REF   1                37,3052   77323 0          CALCRVG
0407                          37,3053   77776 1     EXIT

0408   REF  82  LAST  782     37,3054   0 5301 0    TC    PHASCHNG
0409                          37,3055    10035 0    OCT   10035

0410   REF   3  LAST  536     37,3056   3 4113 0    CAF   OCT31       COPY RN1,VN1,GOT102,GOBL1/2,PIPTIME1
0411   REF  11  LAST  646     37,3057   0 5475 1    TC    GENTRAN     INTO RN ,VN ,GDT/12 ,GOBL/2 ,PIPTIME
0412   REF   6  LAST  528     37,3060    01231 0    ADRES RN1
0413   REF  14  LAST  758     37,3061    01170 0    ADRES RN
04131                         37,3062   0 0003 1    RELINT            GENTRAN DOES AN INHINT
0414   REF  83  LAST  763     37,3063   0 5301 0    TC    PHASCHNG
0415                          37,3064    10035 0    OCT   10035

0416                          37,3065   0 0006 1    EXTEND
0417   REF   3  LAST  780     37,3066   3 1223 0    DCA   AVGEXIT
0416   REF  15  LAST  474     37,3067   52 006 0    DXCH  Z           AVERAGEG EXIT

0419   REF  12  LAST  756     37,3070   3 1205 1 AVGEND CA  PIPTIME +1 FINAL AVERAGE G EXIT
0420   REF   1                37,3071   55«074 1    TS    OLDBT1      SET UP FREE FALL GYRO COMPENSATION

0421   REF  47  LAST  754     37,3072   0 5435 0    TC    UPFLAG      SET DRIFTFLG
0422   REF   3  LAST  722     37,3073    00036 1    ADRES DRIFTFLG    BIT 15  FLAG 2
0425   REF  26  LAST  756     37,3074   0 5261 1    TC    2PHSCHNG
0426                          37,3075    00005 1    OCT   5           GROUP 5 OFF
0427                          37,3076    05022 1    OCT   05022       GROUP 2 ON FOR AVETOMID
0428                          37,3077    20000 0    OCT   20000

0429   REF 202  LAST  782     37,3100   0 6006 1    TC    INTPRET
0430                          37,3101    77624 1    CALL
0431   REF   1                37,3102    27472 0         AVETOMID    CONVERT STATE VECTOR TO REFERENCE SCALE.
0432                          37,3103    77776 1    EXIT

043201 REF 150  LAST  777     37,3104   3 4714 1    CAF   ZERO        ZERO MARK COUNTERS.
043202 REF   9  LAST  574     37,3105   55«125 1    TS    VHFCNT
043203 REF   6  LAST  574     37,3106   55«126 1    TS    TRKMKCNT

04321  REF 233  LAST  782     37,3107   0 4555 0    TC    BANKCALL
04322  REF   1                37,3110    17112 0    CADR  PIPFREE

04323  REF  28  LAST  779     37,3111   4 4702 1    CS    BIT9
043235 REF  16  LAST  575     37,3112   55«734 1    TS    MRKBUF2     INVALIDATE MARK BUFFER
04324                         37,3113   0 0006 1    EXTEND
04325  REF  26  LAST  779     37,3114   03 011 1    WAND  DSALMOUT

043255 REF  50  LAST  752     37,3115   0 5447 0    TC    DOWNFLAG
043256 REF   1                37,3116    00147 0    ADRES CM/DSTBY

04326  REF  51  LAST  783     37,3117   0 5447 0    TC    DOWNFLAG
04327  REF   3  LAST  635     37,3120    00162 1    ADRES V37FLAG
```

```
0433   REF  42  LAST  700    37,3121  3 4704 0            CAF     BIT7
0434   REF  10  LAST  253    37,3122  7 0074 0            MASK    FLAGWRD0
0435                          37,3123  0 0006 1            EXTEND
0436                          37,3124  1 3130 1            BZF     +4

0437   REF  27  LAST  783    37,3125  0 5261 1            TC      2PHSCHNG
0438                          37,3126   00111 0            OCT     111
0439                          37,3127   00132 1            OCT     132

0445   REF  46  LAST  758    37,3130  0 4574 0            TC      POSTJUMP
0446   REF   2  LAST  195    37,3131   10123 0            CADR    CANV37

0447   REF  84  LAST  783    37,3132  0 5301 0  SERVEXIT  TC      PHASCHNG
0448                          37,3133   00035 1            OCT     00035

0449   REF  99  LAST  758    37,3134  1 5112 1            TCF     ENDOFJOB

0450   REF   4  LAST  379      4717             DVTHRUSH EQUALS ELEVEN
A0451
A0452

0453                          37,3135  63401 1  -MAXDELV DEC     -6398
0454                          37,3136  00170 1  JTAGTIME DEC     120

0455                          37,3137  00372 1  2.5SEC   DEC     250
0456                          37,3140  00044 1  MDOTFAIL DEC     144.0 B-16
A0457
A0458
```

RESTORE GROUP 1 + 2 IF P20 IS RUNNING.

1.11SPOT
2.13SPOT

A, 5.3 = REREADAC (ONLY)

15 PERCENT OF 2SEC PIPA ACCUMULATION,
FOR 503-FULL CSM/LEM....DELV SC AT
5.85 CM/SEC.

3200 PPS FOR 2 SEC CCS TAKES 1
= 1 SEC + T CDU, T CDU = .1 SEC

5 SEC MASS LOSS AT 28.8 KG/SEC
SHOULD BE 2-4 SECS FOR NO START
6-8 SECS FOR FAILURE

```
P0459     NORMLIZE PERFORMS THE INITIALIZATION REQUIRED PRIOR TO THE FIRST ENTRY TO AVERAGEG, AND SCALES RN SO THAT IT
R0461   HAS 1 LEADING BINARY ZERO. IN MOST MISSIONS, RN WILL BE SCALED AT 2(+29), BUT IN THE 208 MISSION, RN WILL BE
R0463   SCALED AT 2(+24)M.
 0464   REF   1              37,3141  3 4720 0  NORMLIZE CAP     THIRTEEN      SET UP TO COPY 14 REGS- RN1,VN1,PIPTIME1
 0465   REF  12  LAST  783   37,3142  0 5475 1           TC      GENTRAN       INTO RN,VN, PIPTIME
 0466   REF   7  LAST  783   37,3143   01231 0           ADRES   RN1           FROM HERE
 0467   REF  15  LAST  783   37,3144   01170 0           ADRES   RN            TO HERE

 0468                        37,3145  0 0003 1           RELINT
 0469   REF 203  LAST  783   37,3148  0 6008 1           TC      INTPRET
 0470                        37,3147   45175 0           VLOAD   CALL          LOAD RN FOR CALCGRAV
 0471   REF  16  LAST  785   37,3150   01171 1                   RN
 0472   REF   3  LAST  689   37,3151   77256 0                   CALCGRAV      INITIALISE UNITR RMAG GDT1

 0473   REF   3  LAST  680   37,3152   25207 0           STOVL   GDT/2
 0474   REF   2  LAST   78   37,3153   01258 1                   GOBL1/2
 0475   REF   3  LAST  680   37,3154   01215 0           STORE   GOBL/2
 0476                        37,3155   77778 1           EXIT
 0477   REF 100  LAST  784   37,3156  1 5112 1           TCF     ENDOFJOB
```

```
P0478   *****  PIPA READER *****
R0479                  MOD NO. 00  BY D. LICKLY  DEC.9 1966
R0480   FUNCTIONAL DESCRIPTION

R0481      SUBROUTINE TO READ PIPA COUNTERS, TRYING TO BE VERY CAREFUL SO THAT IT WILL BE RESTARTABLE.
R0483      PIPA READINGS ARE STORED IN THE VECTOR DELV. THE HIGH ORDER PART OF EACH COMPONENT CONTAINS THE PIPA READING,
R0485      RESTARTS BEGIN AT REREADAC.
R0486      AT THE END OF THE PIPA READER THE CDUS ARE READ AND STORED AS A
R0487   VECTOR IN CDUTEMP.  THE HIGH ORDER PART OF EACH COMPONENT CONTAINS
R0488   THE CDU READING IN 2S COMP IN THE ORDER CDUX,Y,Z.  THE THRUST
R0489   VECTOR ESTIMATOR IN FINDCDUD REQUIRES THE CDUS BE READ AT PIPTIME.

R0490   CALLING SEQUENCE AND EXIT

R0491      CALL VIA TC, ISWCALL, ETC.

R0492      EXIT IS VIA Q.
R0493   INPUT

R0494      INPUT IS THROUGH THE COUNTERS PIPAX, PIPAY, PIPAZ, AND TIME2.
R0495   OUTPUT

R0496      HIGH ORDER COMPONENTS OF THE VECTOR DELV CONTAIN THE PIPA READINGS.
R0497      PIPTIME CONTAINS TIME OF PIPA READING.
R0498   DEBRIS (ERASABLE LOCATIONS DESTROYED BY PROGRAM)

R0499           LOW ORDER DELV'S ARE ZEROED FOR TM INDICATION.
R0500           TEMX   TEMY   TEMZ   PIPAGE
 0501                          37,3157  0 0006 1  PIPASR   EXTEND
 0502   REF  26  LAST  736     37,3160  3 0025 0           DCA     TIME2
 0503   REF   7  LAST  778     37,3161  53'246 1           DXCH    PIPTIME1       CURRENT TIME  POSITIVE VALUE
 0504   REF 151  LAST  783     37,3162  4 4714 0           CS      ZERO           INITIALIZE THESE AT NEG ZERO.
 0505   REF   2  LAST   77     37,3163  55'224 0           TS      TEMX
 0506   REF   2  LAST   77     37,3164  55'225 1           TS      TEMY
 0507   REF   2  LAST   77     37,3165  55'226 1           TS      TEMZ
```

```
0508  REF 152  LAST  786  37,3166  3 4714 1        CA    ZERO
0509  REF   5  LAST  779  37,3167  55=166 0        TS    DELVZ      OTHER DELVS OK INCLUDING LOW ORDER
0510  REF   6  LAST  778  37,3170  55=164 1        TS    DELVY

0511  REF  11  LAST  782  37,3171  55=163 0        TS    DELVX +1   LOW ORDER DELV=S ARE ZEROED FOR TM' THUS
0512  REF   7  LAST  787  37,3172  55=165 0        TS    DELVY +1   IF DNLNK=D LOW ORDER DELVS ARE NZ, THEY
0513  REF   6  LAST  787  37,3173  55=167 1        TS    DELVZ +1   CONTAIN PROPER COMPENSATION. IF=0, THEN
A0514                                                              THE TM VALUES ARE BEFORE COMPENSATION.

0515  REF   4  LAST  778  37,3174  55=230 0        TS    PIPAGE     SHOW PIPA READING IN PROGRESS

0516                      37,3175  0 0006 1  REPIP1  EXTEND
0517  REF   9  LAST  781  37,3176  4 0040 1        DCS   PIPAX      X AND Y PIPS READ
0518  REF   3  LAST  786  37,3177  53=225 1        DXCH  TEMX
0519  REF  10  LAST  787  37,3200  52 040 1        DXCH  PIPAX      PIPAS SET TO NEG ZERO AS READ.
0520  REF  12  LAST  787  37,3201  55=162 1        TS    DELVX
0521  REF   8  LAST  787  37,3202  23=164 0        LXCH  DELVY

0522  REF   3  LAST  430  37,3203  4 0041 0  REPIP3  CS    PIPAZ      REPEAT PROCESS FOR Z PIP
0523  REF   3  LAST  786  37,3204  57=226 0        XCH   TEMZ
0524  REF   4  LAST  787  37,3205  56 041 1        XCH   PIPAZ
0525  REF   7  LAST  787  37,3206  55=166 0  DODELVZ  TS    DELVZ

0526  REF 170  LAST  692  37,3207  0 0002 0        TC    Q
0527  REF  24  LAST  779  E6,1661                  EBANK= ACC

0528  REF   3  LAST  649  37,3210  10 763 1  REREADAC  CCS   PHASE5     LAST PASS CHECK
0529                      37,3211  1 3213 0         TCF   +2
0530  REF  44  LAST  761  37,3212  1 5213 0         TCF   TASKOVER

05302 REF   3  LAST  529  37,3213  3 7665 0         CAF   PRIO31     RESTART MAY HAVE WIPED OUT LASTBIAS, AN
05303 REF  11  LAST  724  37,3214  55=074 1         TS    1/PIPADT         UNPROTECTED NOVAC FROM PREREAD,
A05304                                                                    WHICH SET(S) UP 1/PIPADT (THUSLY)
A05305                                                                    FOR NON-COASTING COMPENSATION....BE
A05306                                                                    SURE 1/PIPADT IS ACK. (PRIO31 IS
A05307                                                                    2.0SEC SC.AT B+8CS)

0531  REF   5  LAST  787  37,3215  11=230 0         CCS   PIPAGE
0532  REF   4  LAST  779  37,3216  1 2647 1         TCF   READACCS   PIP READING NOT STARTED. GO TO BEGINNING

0533  REF   1                   37,3217  3 3255 0         CAF   DONEADR    SET UP RETURN FROM PIPASR
0534  REF 171  LAST  787  37,3220  54 002 1         TS    Q

0535  REF   8  LAST  767  37,3221  11=166 0         CCS   DELVZ
0536  REF 172  LAST  787  37,3222  0 0002 0         TC    Q          Z DONE, GO DO CDUS
0537                      37,3223  1 3226 0         TCF   +3         Z NOT DONE, CHECK Y.
0538  REF 173  LAST  787  37,3224  0 0002 0         TC    Q
0539  REF 174  LAST  787  37,3225  0 0002 0         TC    Q
```

```
0540                                37,3226  22 007 0            ZL
0541  REP   9  LAST  787            37,3227  11«164 1            CCS   DELVY
0542                                37,3230  1 3233 1            TCP   +3
0543  REP   1                       37,3231  1 3242 1            TCP   CHKTEMX      Y NOT DONE, CHECK X.
0544                                37,3232  1 3233 1            TCP   +1
0545  REP   5  LAST  787            37,3233  22 041 1            LXCH  PIPAZ       Y DONE, ZERO Z PIP.

0546  REP   4  LAST  787            37,3234  11«226 1            CCS   TEMZ
0547  REP   5  LAST  788            37,3235  4 1228 1            CS    TEMZ        TEMZ NOT = -0, CONTAINS -PIPAZ VALUE.
0548  REP   1                       37,3238  1 3206 1            TCP   DODELVZ
0549                                37,3237  1 3235 1            TCP   -2
0550  REP   9  LAST  787            37,3240  23«166 1            LXCH  DELVZ       TEMZ = -0, L HAS ZPIP VALUE.
0551  REP 175  LAST  787            37,3241  0 0002 0            TC    Q

0552  REP   4  LAST  787            37,3242  11«224 0  CHKTEMX    CCS   TEMX        HAS THIS CHANGED
0553  REP   5  LAST  788            37,3243  4 1224 0            CS    TEMX        YES
0554                                37,3244  1 3247 1            TCP   +3          YES
0555                                37,3245  1 3243 0            TCP   -2          YES
0556  REP   1                       37,3246  1 3175 0            TCP   REPIP1      NO
0557  REP  13  LAST  787            37,3247  55«162 1            TS    DELVX

0558  REP   3  LAST  786            37,3250  4 1225 1            CS    TEMY
0559  REP  10  LAST  788            37,3251  55«164 1            TS    DELVY

0560  REP 153  LAST  787            37,3252  4 4714 0            CS    ZERO        ZERO X AND Y PIPS
0561  REP  11  LAST  787            37,3253  52 040 1            DXCH  PIPAX       L STILL ZERO FROM ABOVE

0562  REP   1                       37,3254  1 3203 1            TCP   REPIP3

0563  REP   1                       37,3255   02650 0  DONEADR   GENADR PIPSDONE
```

```
R0564  ********************************************************************************************************

R0566          ROUTINE CALCRVG INTEGRATES THE EQUATIONS OF MOTION BY AVERAGING THE THRUST AND GRAVITATIONAL
R0566  ACCELERATIONS OVER A TIME INTERVAL OF 2 SECONDS.

R0569          FOR THE EARTH-CENTERED GRAVITATIONAL FIELD, THE PERTURBATION DUE TO OBLATENESS IS COMPUTED TO THE FIRST
R0571  HARMONIC COEFFICIENT J.

R0572          ROUTINE CALCRVG REQUIRES...
R0573                1) THRUST ACCELERATION INCREMENTS IN DELV SCALED SAME AS PIPAX,Y,Z IN STABLE MEMBER COORDS.
R0575                2) VN SCALED 2(+7)M/CS IN REFERENCE COORDS.
R0576                3) RN SCALED AT 2(+29) METERS IN REFERENCE COORDS.
R0577                4) UNITW THE EARTH S UNIT ROTATIONAL VECTOR (SCALED AS A FULL UNIT VECTOR) IN REFERENCE COORDS.

R0579  IT LEAVES RN1 UPDATED (SCALED AT 2(+29)M, VN1 (SCALED AT 2(+7)M/CS), AND GDT1/2 (SCALED AT 2(+7)M/CS). ALSO HALF
R0561  UNIT VECTOR UNITR, RMAG IN 36D SCALED AT 2(+29)M, R MAG SQ. IN 34D SCALED AT 2(+58) M SQ.
R0563

 0584                          37,3256  41456 0  CALCGRAV UNIT   PUSH          ENTER WITH RN IN MPAC
 0585  REF   1                 37,3257  01760 1           STORE  UNITR
 0586                          37,3260  67340 1           LXC,1  SLOAD
 0587  REF  14  LAST  660      37,3261  03746 1                  RTX2
 05671 REF  34  LAST  741      37,3262  00047 1                  X1
 0588                          37,3263  77240 1           BVN    VLOAD
 05661 REF   1                 37,3264  77312 1                  ITISMOON
 0589                          37,3265  41441 0           DOT    PUSH
 0590  REF   6  LAST  766      37,3266  01714 1                  UNITW
 0591                          37,3267  44316 0           DSQ    BDSU
 0592  REF   1                 37,3270  37364 1                  DP1/20
 0593                          37,3271  56325 0           PDDL   DDV
 0594  REF   1                 37,3272  37366 0                  RESQ
 0595                          37,3273  00043 0                  34D           (RN)SQ
 0596                          37,3274  00041 1           STORE  32D           TEMP FOR (RE/RN)SQ
 0597                          37,3275  41205 0           DMP    DMP
 0598  REF   1                 37,3276  37370 1                  20J
 0599                          37,3277  65361 0           VXSC   PDDL
 0600  REF   2  LAST  789      37,3300  01760 1                  UNITR
 0601                          37,3301  41205 0           DMP    DMP
 0602  REF   1                 37,3302  37372 0                  2J
 0603                          37,3303  00041 1                  32D
 0604                          37,3304  53361 0           VXSC   VAD
 0605  REF   9  LAST  769      37,3305  01714 1                  UNITW
 0606                          37,3306  77626 0           STADR
 0607  REF   3  LAST  785      37,3307  76521 0           STORE  GOBL1/2
 0608                          37,3310  41455 0           VAD    PUSH
 0609  REF   3  LAST  769      37,3311  01760 1                  UNITR
 0610                          37,3312  60345 0  ITISMOON DLOAD  NORM
 0611                          37,3313  00043 0                  34D
 0612  REF  14  LAST  741      37,3314  00050 1                  X2
 06121                         37,3315  53663 1           BDDV*  SLR*
```

```
06122 REP   1                37,3316  37356 0                  -MUDT(E),1
0613                         37,3317  56623 0                  0 -21D,2
0614                         37,3320  45561 1          VXSC    STADR
0615  REP   2  LAST   77     37,3321  78527 0          STORE   GDT1/2          SCALED AT 2(+7) M/CS
0616                         37,3322  77818 0          RVQ

0622                         37,3323  74375 0 CALCRVG  VLOAD   VXSC
0623  REP   9  LAST  782     37,3324  01183 1                  DELV
0624  REP   2  LAST  782     37,3325  37354 1                  KPIP1
0625                         37,3326  76505 0          VXM     VSL1
0626  REP  32  LAST  772     37,3327  01738 1                  REFSMMAT
0627  REP   7  LAST  677     37,3330  03433 0          STORE   DELVREF         DELV IN REF COORDS AT 2(+7)
0628                         37,3331  41582 0          VSR1    PUSH
0629                         37,3332  41455 0          VAD     PUSH            (DV-OLDGDT)/2 TO PD SCALED AT 2(+7)M/CS
0630  REP   4  LAST  785     37,3333  01207 0                  GDT/2
0631                         37,3334  74255 0          VAD     VXSC
0632  REP  12  LAST  758     37,3335  01177 1                  VN
0633  REP   1                37,3338  37362 1                  2SEC(22)
0634                         37,3337  44055 1          VAD     STQ
0635  REP  17  LAST  785     37,3340  01171 1                  RN
0636                         37,3341  00037 0                  31D
0637  REP   8  LAST  785     37,3342  35232 1          STCALL  RN1             TEMP STORAGE OF RN SCALED 2(+29)M
0638  REP   4  LAST  785     37,3343  77258 0                  CALCGRAV

0639                         37,3344  53255 0          VAD     VAD
0640                         37,3345  77655 1          VAD
0641  REP  13  LAST  790     37,3348  01177 1                  VN
0642  REP   3  LAST  529     37,3347  35240 1          STCALL  VN1             TEMP STORAGE OF VN SCALED 2(+7)M/CS
0643                         37,3350  00037 0                  31D

0644                         37,3351  03215 1 KPIP     2DEC    .1024           SCALES DELV TO 2(+4)
0644                         37,3352  27057 0
0645                         37,3353  02312 0 KPIP1    2DEC    0.074880        207 DELV SCALING. 1 PULSE = 5.85 CM/SEC.
0645                         37,3354  32537 1
0646                         37,3355  61377 0 -MUDT(E) 2DEC*   -7.9720645 E+12 B-44*
0646                         37,3356  55754 1
0647                         37,3357  77844 1 -MUDT(M) 2DEC*   -9.805556 E+10 B-44*
0647                         37,3380  65556 1
0648                         37,3361  00000 1 2SEC(22) 2DEC    200 B-22
0648                         37,3362  31000 0

0649                         37,3363  01463 1 DP1/20   2DEC    0.05
0649                         37,3384  06315 0
0650                         37,3365  00001 0 RESQ     2DEC*   40.6809913 E12 B-59*
0650                         37,3368  05000 1
0651                         37,3387  02047 0 20J      2DEC*   3.24692010 E-2 B1*
0651                         37,3370  36332 0
0652                         37,3371  00152 1 2J       2DEC*   3.24692010 E-3 B1*
0652                         37,3372  14511 1
```